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OCTOBER • 1945

Designing Insulation and Ventilation for Animal Housing — *James L. Strahan*

Agricultural Engineers Develop Tung Nut Decorticator — *I. F. Reed, R. E. Jezek*

New Method of Steel Fabrication for Farm Building Frames — *Stanley A. Witzel*

Research Studies in the Performance of Grain Bin Floors — *E. R. Gross*

Engineering Aspects of Blanching Fruits for Dehydration — *Russell L. Perry et al*

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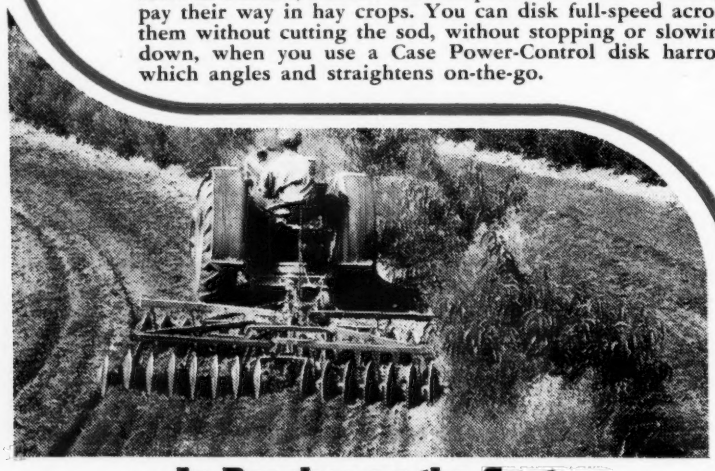
Non-Stop Disking
Speeds Advanced Farm Practices

• • Skips Grassed Waterways

Strong, close-growing stalks of grass and a solid network of roots in a broad, shallow channel protect soil from washing, pay their way in hay crops. You can disk full-speed across them without cutting the sod, without stopping or slowing down, when you use a Case Power-Control disk harrow which angles and straightens on-the-go.



• • In Peaches on the Contour

This modern orchardist can cross the vegetative buffer strips in the contoured rows without cutting and without stopping. Also, his Case Power-Control disk harrow has no long levers sticking up to catch in overhanging limbs. It angles and straightens on power from the turning of its own blades, all at the pull of a trip-rope from the tractor seat.

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A pull of the trip-rope and you turn at the end with gangs straight—no digging or piling of dirt. It lightens the turning load on the tractor, makes steering easier. The Case Power-Control harrow has no complicated hook-up—just an ordinary drawbar hitch and a trip-rope. It is built both single and tandem, in several sizes. Postal card will bring you free folder.

This message is one of many appearing in the farm papers. It is based on the belief that a good way to promote advanced practices is to presume their desirability, then "sell" methods and machines for their specific application. Case bulletins and talkie films on terracing with moldboard and one-way disk plows, on contour farming, and on putting up high-protein hay are available for your use.
J. I. Case Co., Racine, Wis.

★

CASE

IT'S EASIER TO MOVE

Plywood Hog Houses

Sanitation is one of the most important factors in successful hog raising.

Raising pigs on pasture is a well-established system of hog management which makes it easier to keep them in clean surroundings and gives the low-cost gains of grass feeding.

Farrowing at the barn lot, moving the sow and litter with their portable house to a clean spot in verdant pasture, changing their location one or twice during the growing season, and returning hogs and shelter to the barn lot for a concentrated feeding-out period does require special attention to the equipment, however. The house must be easily cleaned, light and warm to give the young pigs a good start. It must be sturdy and durable to withstand the strains developed in moving over rough ground. It must be light-weight to facilitate moving. It must be designed to provide a warm nest for the young pigs and a cool, well-ventilated shelter for the heavier feeder pigs. And, finally, it must be economical both in first cost and in the annual housing charge based on its years of serviceability.

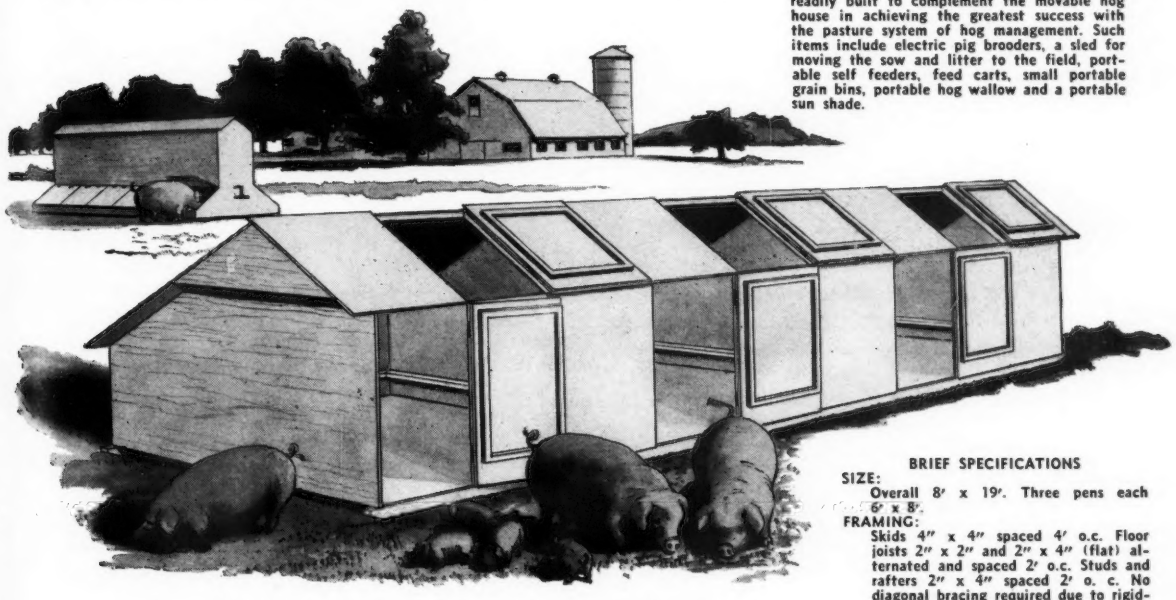
It is necessary for the equipment through its labor-saving features, its durability and low cost to balance such inconvenience as arises from the task of feeding and watering the animals at some distance from the barnyard. It is especially important that the house be easy to move; otherwise the farmer will often penalize himself with the additional problems of scattered houses and the unsanitary conditions resulting from keeping animals on unclean ground.

The three-pen plywood hog house illustrated (Midwest Plan No. 72609) has been designed to meet these requirements. It provides clean, comfortable shelter for pigs of all ages. Housing for three litters can be moved in one operation. It is easy to move because of its light weight—1500 pounds as compared to 2400 pounds for similar houses built of other materials. Structural tests prove it to be capable of rough handling without damage. The initial cost is approximately the same as for similar houses using other sheathing materials, but the added length of productive life due to its structural superiority results in appreciably lower animal housing costs.

Plywood offers a number of very definite advantages over other sheathing materials for this type of construction. Large, light-weight and easily fabricated panels facilitate construction. Plywood has thermal insulation value, and is warm to the touch.

Its equalized strength properties, freedom from splitting when nailed or in service and resistance to puncture simplify construction and give greater structural value. The large sheets eliminate joints which allow wind to blow through so a plywood house is warmer in windy weather. Nailed to the framing, plywood panels provide greater strength and stiffness than in any other conventional sheathing; gluing and nailing more than doubles its initial structural contributions.

Other plywood equipment items may be readily built to complement the movable hog house in achieving the greatest success with the pasture system of hog management. Such items include electric pig brooders, a sled for moving the sow and litter to the field, portable self feeders, feed carts, small portable grain bins, portable hog wallow and a portable sun shade.



Perspective sketch of hog house in pasture. A movable plywood 3-pen hog house and other inexpensive equipment of plywood construction is a large part of the answer to labor-saving in the sanitary pasturing system of hog management.

BRIEF SPECIFICATIONS

SIZE:
Overall 8′ x 19′. Three pens each 6′ x 8′.

FRAMING:
Skids 4″ x 4″ spaced 4′ o.c. Floor joists 2″ x 2″ and 2″ x 4″ (flat) alternated and spaced 2′ o.c. Studs and rafters 2″ x 4″ spaced 2′ o. c. No diagonal bracing required due to rigidity imparted by plywood sheathing.

FLOOR:
½″ EXTERIOR-type Douglas fir plywood.

WALLS:
½″ EXTERIOR-type Douglas fir plywood.

ROOF:
⅜″ EXTERIOR-type Douglas Fir plywood.

ASSEMBLY:
Nailing with 6d galvanized nails spaced 6″ o.c. at panel edges and 12″ o.c. at intermediate points is adequate. Gluing and nailing gives ultimate structural strength and rigidity. Use moisture-resistant casein or urea formaldehyde resin glue. (Insoluble resorcinal formaldehyde resin adhesives to set at 70°F will be available postwar).

PAINTING:
Two or three coats standard mixed exterior paint on walls and roof. Use double usual amount of linseed oil in prime coat. Light color desirable to reflect sun's heat. Floor may be given two coats asphalt paint with sand sprinkled into last coat.

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AGRICULTURAL ENGINEERING

Established 1920

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EDITORIAL

Rational Design and Research

CRITICAL evaluation must come, of course, only from his professional peers, but we venture the guess that James L. Strahan's paper, published as the leading article in these pages, will stand as a landmark not only in his own consistently constructive career but in the advance of farm building design. As he himself is first to point out, specific values proposed will be revised as underlying data are more accurately and more completely determined. But at least he has provided a pattern for rational procedure to supplement, if not to supersede, the empirical approach.

Readers will recall the appearance in these pages, from time to time in recent years, of other papers on rational design, notably in the realm of agricultural water management. They may have bored and bewildered many of us with their unfamiliar concepts and mathematical niceties. But they are the building blocks which bring advancement to our profession and blessings both to agriculture and to the America which looks to the farm not only for food and fiber but for markets and men.

In all fields, as Mr. Strahan points out for his own, rational design must await availability of basic data derived from research. Much of it must come from pure science and from branches of engineering other than our own. Nevertheless, we should be leaders, not leaners. We should be so aggressive in research that in the clearinghouse of technology we shall lend at least as much as we borrow. Only thus, as pointed out by Dr. Trullinger elsewhere on this page, will the profession of agricultural engineering hold high place among kindred professions.

Research and rational design are of especial need in farm structures. When technical transition was slow, and even now in the case of short-lived equipment, the empirical methods of experience and observation were and may be fairly adequate. But in the case of buildings, replacement cannot well take the place of research. Only rational design can create with confidence structures to suit swiftly changing conditions and demands.

Education for Research

"WE NOW know that research was the deciding factor in the war on both sides of the world. We did more and better research than the enemy, and we did it *first*. It is now disturbingly clear that the enemy was not far behind us," says Past-President R. W. Trullinger of the American Society of Agricultural Engineers in a letter written to the Society's secretary and relayed to the membership.

"I have never been fully satisfied that agricultural engineers have taken full advantage of opportunities offered them to engage in research. I realize that they frequently had little encouragement to enter research . . . however, I believe that the ultimate limiting factor has been inadequate education in the technical, physical, and biological sciences. Many a young agricultural engineer has come to me with a burning desire to get into research, but with no great stomach for the task of acquiring the additional knowledge of science required."

Dr. Trullinger's message, which we cannot quote in full here, was inspired by thoughts of agricultural engineers returning from the armed services, especially the large number of recent or impending graduates who for the most part have only a bachelor's degree and as a rule are hardly qualified to become leaders in research. He suggests that the Society as such might properly direct the attention of such young engineers to the desirability of further education for the opportunities that abound in the realm of research. Certainly, he urges, members as individuals should use their influence to that end.

Touching on the deluge of "science-revealing stories (mostly wrong) about the atomic theory" detonated by the atomic bomb he asks why agricultural engineers should not delve into the agricultural possibilities of the atomic and other theories. Why not, indeed? To explore every source and every application of every kind of energy to the biological processes of agriculture is the obvious business of agricultural engineering research. It is time to take a larger part in "'world-startling" developments.

Remember the Reichsbanknote

FOR what he calls its "great moral lesson" a member of the American Society of Agricultural Engineers preserves and on occasion exhibits a relic of the German inflation of the early 1920's, Reichsbanknote C-04106747 in the denomination of 100,000 marks. He brings it to our attention as a warning of what, in greater or less degree, will occur here if the current campaign for a 30 per cent rise in the wage level should be successful, followed as it needs must by comparable rise in the price level.

Protests by partisans and mild rebukes by advocates of professional isolationism to the contrary notwithstanding, it becomes increasingly difficult to ignore the impact of politics and other social phenomena on our profession and the agriculture which it serves. We may blind our eyes to the palpable proposition that a general rise of 30 per cent in wages and prices is a discount of 23 per cent in purchasing power of every war bond bought and held, every payment of insurance benefits, every deferred payment defined in dollars. Infliction of fraud on the general public may be none of our professional business.

When, however, we see the $1000 war bond earmarked for a tractor able to buy only $770 worth of power, $5000 patiently saved for farmstead modernization marked down to $3850 worth of buildings, and so on with all the farm funds patriotically withheld from spending during the dearths of war, we doubt it our duty to be blind and dumb. Our farmers and our profession have waited too long for them to acquiesce by silence in a policy of appeasement that cuts 23 per cent from their planned improvements.

Though not a question of the hour, it is equally true that deflation is a fraud on the taxpayer and a discount in the earnings of agriculture, as we all remember too well. Indeed, an added reason for resisting inflationary forces is the likelihood that they eventually will bring reaction and deflation. For the sake of agriculture and its engineering, at least, the thing most to be desired is stabilization of prices at levels approximating those of the war period. Increases in wages and in farm income are desirable, of course, but the way to win them is by increased productivity per man. Increasing output per man is the business of the engineer, and he has done it so well that none can rightly question his objection to unsound shortcuts.

STUBBLE-MULCH TILLAGE AS A CONSERVATION STEP

HERE is what Cecil H. Werneke, Caldwell, Kansas, considers a triple-duty conservation outfit.

The 16-tooth Soil Control cultivator rips open the soil 8" to 10" deep — to take and store moisture. By leaving stubble, straw and clods on the surface it provides resistance to wind erosion. Pulled along the contours, this deep-working tool helps reduce erosion by run-off.

It takes heavy-duty power to pull this chisel-type implement in hard soil. For example, Mr. Werneke's experience indicates that its draft per foot of width approximates 400 pounds — gives a total load of about 6400 pounds — when worked at full depth in heavy gumbo.

And beyond the saving of soil and moisture is another angle — cash-conservation.

"The Diesel D4 burned only eighty cents worth of fuel, tilling one twenty-six-acre field with this tool," states Mr. Werneke.

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AGRICULTURAL ENGINEERING

VOL. 26 OCTOBER, 1945 No. 10

A Method for Designing Insulation and Ventilation for Animal Shelter Buildings

By James L. Strahan

FELLOW A.S.A.E.

INSULATION for animal-shelter buildings has been recognized as essential for good performance of a ventilating system for only a comparatively short time. Practice has indicated certain empyrical standards to be reasonably satisfactory but they are at best only fairly good guesses. Probably the reason that rational design has not been proposed is that available fundamental biological data on heat and moisture production by livestock has not been recognized and accepted as a valid basis for design.

It is the purpose of this paper to present a method for computing the amount of insulation required for any given set of housing conditions and to indicate how this can be correlated with the design of a ventilating system.

Before an economical and physically acceptable answer can be given to the question of how much heat must be saved by means of insulation, it is essential to know how much heat is available and what job is required of it.

There are some sources of information on heat and moisture production by livestock which, though admittedly not entirely satisfactory, yet should serve the building designer's purpose until more data is available, particularly if it is used only to set up a rational method which can be further checked against field observations before being recommended in practice. These sources stem primarily from calorimetric studies at Pennsylvania State College, the University of Illinois, the University of Missouri, and others. Some data are available on dairy cows, cattle, poultry and swine.

Dairy Cows. Armsby[1]* in 1921 presented a method of computing the heat production of dairy cows based upon a formula involving calorimetric determination of fasting katabolism to which he added heat increments due to various feed rations, of which the thermal characteristics of the components had previously been determined. He has tabulated the total heat and moisture production for various categories of dairy animals as follows:

	Total heat produced		Moisture produced	
	Calories per day	Btu per hour	Grams per day	Grains per hour
900-lb Jersey producing 20 lb milk per day	16,313	2,691.6	6,947	4,466
900-lb Jersey producing 30 lb milk per day	18,273	3,015.0	7,782	5,003
1,250-lb Holstein producing 30 lb milk per day	19,905	3,284.4	8,477	5,450
1,250-lb Holstein producing 45 lb milk per day	22,372	3,691.4	9,528	6,125

The values for heat are based upon a fasting katabolism of 6,000 cal (calories) per day per 1,000 lb of live weight to

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

JAMES L. STRAHAN is agricultural engineer, Flintkote Company.

* Superscript numbers refer to appended references.

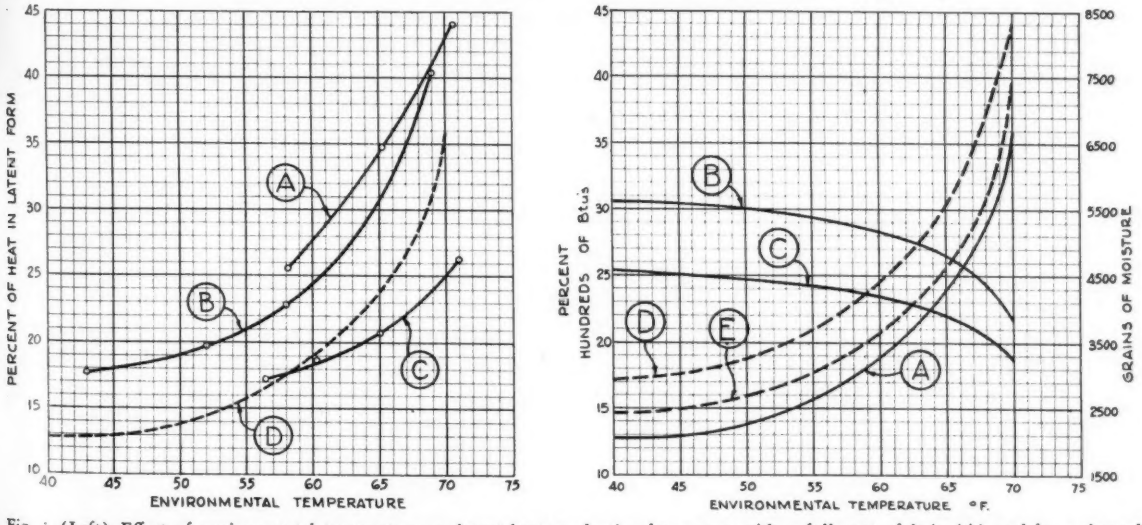


Fig. 1 (Left) Effect of environmental temperature on latent heat production by a steer with a full coat of hair (A) and by a sheared steer (C), from University of Pennsylvania data. Curve B is for 1000-lb steers at the University of Illinois. Curves B and A check fairly closely. Curve D represents the assumed reaction of dairy cows • Fig. 2 (Right) Effect of environmental temperature on heat and moisture production by dairy cattle: A, per cent of heat in latent form; B, sensible heat in Btu per hour produced by large cows; C, sensible heat in Btu per hour produced by small cows; D, grains of moisture produced per hour by large cows; E, grains of moisture produced per hour by small cows

which has been added heat increments derived from rations typical for animals producing on the stated levels. The values for moisture production are based on the assumption that 25 per cent of the total heat is in latent form.

From Armsby's work it might be inferred that building design factors for heat and moisture production can be considered as *constants* by the engineer. Other writers, however, bring out the significant fact that they are variable and depend upon environmental temperature. For instance, the results of experiment 186 as reported by Forbes, Braman, Kriss, et al[2] indicate that 24.34 per cent of total heat produced by a shorthorn steer was in latent form when environmental temperature was 66 F (19 C), and that this value dropped to 17.44 when the environmental temperature was lowered to 56 F (13.5 C). A ten-degree reduction in temperature resulted in an increase of sensible heat of almost 7 per cent of the total, or 10 per cent of the amount previously available to warm the building.

In another case, that of a steer with a full coat of hair reported in the same publication, the per cent of latent heat increased from 25.57 to 44.15 as the environmental temperature was increased from 60.6 F to 70.7 F. On the other hand, a similar animal, sheared, emitted only 17.26 per cent of its heat in latent form at 56.6 F, this percentage rising to 26.46 per cent at 71 F; curves A and C in Fig. 1 are plotted from these data.

Mitchell and Hamilton[3] at the University of Illinois, seeking an evaluation of those factors which affect "insensible loss in body weight" found that varying environmental temperatures, ranging from 69 F down to 43 F, resulted in a decrease in the percentage of latent heat from 40.5 to 17.9 in the following sequence, as shown by curve B, Fig. 1:

Environmental temperature	Per cent of latent heat
69	40.5
58	22.8
52	19.7
43	17.9

The work was done with steers weighing approximately 1,000 lb whose average daily heat production was 10,473 cal, or at the rate of 1,728 Btu per hour on not much more than a maintenance ration. Inasmuch as there was no statement in the report that they were sheared, it is presumed that they had a full coat of hair during the experiments.

NO DIRECT CALORIMETRIC WORK ON DAIRY CATTLE TO DEVELOP HEAT-PRODUCTION STATEMENT

Unfortunately, no direct calorimetric work has been done on dairy cattle, or at least none has been reported in such form as to enable the engineer to develop an unquestionably acceptable heat-production statement. There does, however, appear to be a clue to what happens in the case of dairy cows in the fact that shearing has a marked effect on percentage of latent heat produced by steers. It seems reasonable to infer from this that the critical temperature of an animal housed under comparatively artificial conditions, as is the dairy cow, will be relatively high with a correspondingly low percentage of latent heat production, and therefore of moisture production.

On this assumption I have drawn the latent heat curve D, Fig. 1, which lies at approximately the same level as curve C, indicating the reaction of a *sheared* steer, and have carried it through the lower ranges of environmental temperature about parallel to the lower half of curve B. In other words, I have assumed that the dairy cow will react to her environment in about the same manner as a steer with a full coat of hair but at a lower level of moisture production.

The Rational Design Problem. For design purposes the engineer is required to make certain assumptions if anything approaching a rational solution is to be accomplished. They are as follows:

1 *Heat and moisture production must be standardized.* It has been shown that heat production varies broadly with body weight and plane of nutrition, and between different individuals of apparently equal physical characteristics, as well as between different periods of time for the same individual. Furthermore, herds are constantly varying as to number, size of animals, and, to some extent, breed. For design purposes average heat production values must therefore be assumed. Assuming an average total amount of heat produced and knowing the manner in which latent and sensible heat varies, it is possible to determine both the heat available for warming and the amount of moisture produced *at any given environmental (or barn) design temperature.* It is for this purpose that the chart (Fig. 2) was constructed.

2 *Ventilation is the only variable factor.* After the stable is built there can be no change in any of those design factors which affect temperature control, except the one of ventilation or air change. The size and shape of the building and the insulation characteristics of the walls and ceiling are set. However, ventilation can be varied to compensate for heat losses under different climatic conditions, principally temperature variations.

3 *Minimum tolerable temperature is a constant factor.* It must be assumed, for purposes of design, that stable temperature will remain constant at the lowest level that the operator will tolerate in cold weather. As heat production by the animal varies with environmental temperature, it is reasonable to depend upon the availability under the most adverse conditions of an amount of heat which is appropriate to that lowest tolerable temperature. Then when the stable temperature rises, due to moderation of the weather, although less sensible heat will be available, less will be required. More latent heat and therefore more moisture will be produced but at a time when more ventilation can be tolerated from the standpoint of temperature control.

TWO HEAT-PRODUCTION FACTORS DESIRABLE FOR LARGE AND SMALL BREEDS OF DAIRY CATTLE

4 *Two heat production factors are desirable.* Because some stables are designed for large breeds, such as Holsteins and Ayrshires, while others are designed for small ones, such as Jerseys and Guernseys, it seems desirable to establish two heat factors. It is suggested that Armsby's figures for *total heat production* be accepted until research discloses others to be more accurate and that the two lower ones and the two higher ones be averaged separately, setting the value at the nearest 100 Btu. For small cows this amounts to 2,900 Btu per hr and for large ones to 3,500 Btu per hr.

Sensible Heat Production. The amount of sensible heat available at any given environmental temperature will be equal to the total amount produced multiplied by the difference between 100 per cent and the percentage in latent form at that temperature. Curve A, Fig. 2, which is the same as curve D in Fig. 1, indicates that at, for instance, 50 F, 14 per cent of the heat is latent. Therefore, 86 per cent will be sensible. As the large cows will produce an average of 3,500 Btu per hour, 86 per cent of this, or 3,010 Btu, will be sensible and available at that temperature to warm the air in the building and compensate for conduction and radiation losses. In like manner 2,494 Btu will be available, on the average, from the small cows. Similar calculations for other environmental temperatures produced

the values from which curves B and C, Fig. 2, were plotted.

Moisture Production. Since the latent heat of one gram of water vapor is 2.32 Btu, the number of grams of water vaporized can be determined by dividing this figure into amount of latent heat produced by the animals.

At an environmental temperature of 50 F, 14 per cent of the total heat is in latent form (curve A). As the total heat for large cows is 3,500 Btu, the latent heat will be $3{,}500 \times 0.14 = 490$ Btu, and the amount of water vaporized will be $490 \div 2.32 = 211.2$ g (grams). This amounts to $211.2 \times 15.432 = 3{,}259$ grains per hour per cow. A similar computation for small cows produces a value of 2,701 grains.

Repeating these calculations for other environmental temperatures developed the data from which the moisture-production curves D and E, Fig. 2, were drawn.

In order to obtain basic design data for a dairy stable from these curves, it is necessary only to assume the minimum tolerable inside temperature and select values for sensible heat and moisture appropriate to this temperature. At an inside temperature of 45 F, for instance, the heat value for large cows is 3,045 Btu and the moisture value is 3,026 grains. For small cows they are, respectively, 2,523 Btu and 2,508 grains.

Temperature Difference. Since temperature difference is the determining factor in designing for insulation there must be a satisfactory basis for assuming or estimating both inside and outside temperatures.

Inside Temperature. In some animal-shelter buildings inside temperature has been physically limited by the amount of live weight housed. Artificial heat might be used if the added control of temperature thereby attained were considered essential from a management standpoint. This is true of the heat-deficient centralized hog farrowing house where artificial heat is frequently used for early farrowing. It is not generally true of the poultry laying house, where artificial heat is seldom, if ever, used. The amount of natural heat in a properly designed dairy stable, however, is ordinarily sufficient to maintain desirable inside temperatures in the coldest weather without recourse to any artificial source. There appears to be no agreement upon optimum inside temperature, some operators being willing to tolerate much lower levels than others. Thus this matter is largely a question of management and individual preference. Therefore, because it is not significant from the standpoint of design procedure, no attempt will be made here to justify any standard.

Outside Temperature. Outside temperature is highly variable as between localities and as between seasons. Furthermore, it fluctuates through wide ranges within short periods of time, i.e., 24 hrs. But for design purposes one value of outside temperature must be established in order to determine the temperature difference against which the animals in the building must be protected. Attempts to do this have been made principally in two different ways. The first, which on the surface appears most logical, is to divide the country into climatic zones, and to arrive at appropriate values by averaging data obtained from U. S. Weather Bureau reports over a long period of time. Kelley[4] in 1924 published a zone map which delineated four zones numbered 1, 2, 3, and 4 from north to south on which the Weather Bureau reported as follows:

Zone	Daily mean minimum temperature, January and February	Mean monthly temperature	Lowest recorded temperature
1	5F	9-12F	-57F
2	17F	22F	-43F
3	27F	30F	-22F
4			-11F

Essentially the same climatic breakdown, into four zones, was published by T. A. H. Miller et al[5] in 1945, but here the lines were modified slightly to give weight to daily hours of sunshine and average relative humidities. Miller states that minimum temperatures of about 40 F below the January average may occur once or twice a year in most of zones 1 and 2, whereas in zones 3 and 4 such temperatures are usually about 30 deg below the January average. It is significant to note that average temperatures within all zones drop at the rate of about 1F for each 400-ft rise in elevation.

For design purposes zonal temperature has the serious disadvantage of being too rigid. It is no more than an arithmetical average of data which varies through a wide range, even within a single zone. The average temperature at a locality along the southern edge of, for instance, zone 2 would vary much more from that of a locality along its northern edge than the latter would from a locality along the southern edge of zone 1. Yet design for these zone 2 locations would be controlled by the same outside design

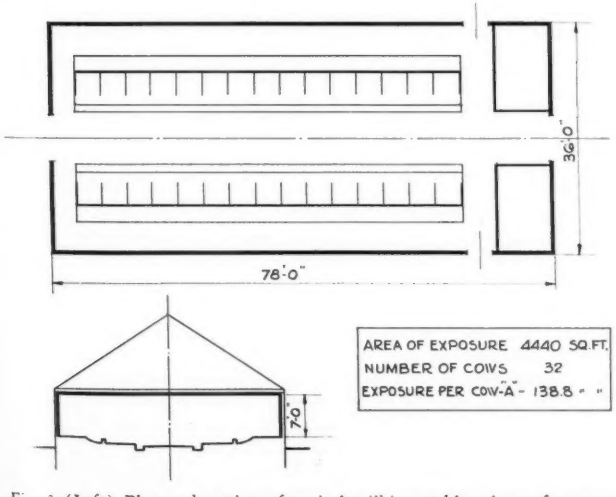
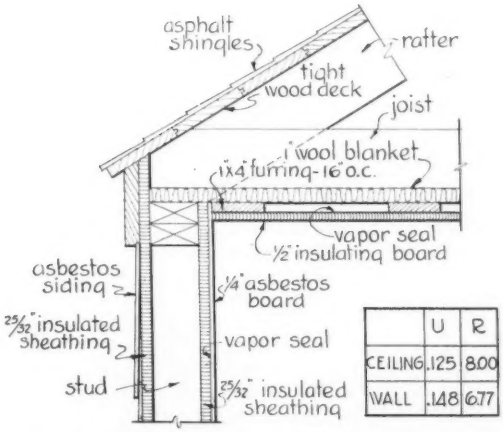


Fig. 3 (Left) Plan and section of typical milking stable. Area of exposure includes walls, ceiling, windows and doors • Fig. 4 (Right) Sections of ceilings that satisfy the insulation requirements



temperature, whereas design for the zone 1 location would be governed by a much lower outside temperature value. Thus, it is conceivable that two barns close together, and adjacent to but on opposite sides of a zone division line, would carry very different insulation specifications to conform to the zonal recommendations, but in reality would be subjected to practically the same weather conditions. Of course, the obvious cure for this situation is to increase the number of zones, a procedure which would then be subject to the criticism that it overcomplicates the problem.

If, in the light of this analysis, the zone method of arriving at outside temperature breaks down, what can be offered in its place? Recommendations by the American Society of Heating and Ventilating Engineers[6] suggest a procedure that might be considered for use in animal-shelter design. The guide for 1945 states, "There are no hard and fast rules for selecting the outside-design temperatures to be used for a given locality or type of building or heating system, and the problem is to some extent a matter of judgment and experience". In addition to indicating a zone chart having 6 zones (two more than Kelley's), it tabulates the extreme temperatures which have been reported at individual cities over the country. Thus data of local significance is made available to the designer. The Society is compiling outside design temperatures which are equalled or exceeded during 97½ per cent of the hours in December, January, February, and March which it proposes to recommend for use as soon as it is completed. These may or may not prove to be acceptable for animal-shelter design.

At this point a fundamental distinction should be noted between design of a building that is to be heated artificially and one which is to be heated, so to speak, biologically. In the latter the heating plant is fixed. It is limited by the maximum animal population of the building when in use. In the former the heating plant is designed to meet the requirements of the situation. Lower insulating values in the construction can be compensated for by increased capacity of the heating plant, whereas there is a definite limit to the amount of stoking that can be done to a herd of cows out of the feed bin, or to the number that can be crowded into a stable. Therefore, in any given situation, it will probably be found desirable to select an outside design temperature for animal housing that is safe on the low side.

TO DESIGN INSULATION FOR TEMPERATURE DIFFERENCES INSTEAD OF FOR ZONES IS RECOMMENDED

In the light of the foregoing, the following procedure is suggested. Design insulation for various *temperature differences* instead of for various *zones*. Let the client select temperature values appropriate to his local conditions of both climate and management as he understands and knows them from his own experience. When designing for an individual client the engineer can select specific inside and outside design temperatures in conference with his client and be governed accordingly. When designing for a wider area, as, for instance, a state or group of states, he can make recommendations for a range of conditions which will vary in increments of 5 or 10 deg of temperature differences. In the accompanying discussion he can then indicate a method of adapting the recommendations to individual requirements. This will leave the final selection of specifications up to the man who will use and pay for them. If such discussion adequately presents the functional limitations of the recommended specifications, the client will be safeguarded in his use of them.

Having established a basis for obtaining data on heat and moisture production, and also what seems to be a reasonable method for tying in the factor of climate, it will now be of interest to inquire whether a design method can be developed which will produce specifications at all consistent with presently accepted practice and observed performance.

Design Procedure.

I The determination of the proper amount of insulation to use in any individual case must be preceded by a general plan solution of the over-all design problem. The height of walls, type of roof, location and size of windows and door must be decided. When the plan is available and location of the building known it will be possible to

II Determine the total area in square feet of exposure to heat loss by conduction and radiation from the building. Determine area of exposure per animal *(A)*.

III Set forth the climatic and management design factors as follows:

1 Minimum allowable inside temperature. Call this factor *T*.
2 Maximum allowable relative humidity.
3 Temperature difference, *T-t* or *D*.
4 Sensible heat available per animal unit per hour at environmental temperature *T*. (Curve B or C, Fig. 2)
5 Grains of moisture produced per animal unit per hour at environmental temperature *T*. (Curve D or E, Fig. 2)

IV Compute the minimum volume of air change under restricted ventilation in cubic feet per hour per animal unit.

V Compute the value of *AC*, allowable heat loss in Btu per degree of temperature difference per hour per animal unit.

VI Compute the value of *C*, average heat transmission coefficient per square foot per hour per degree of temperature difference.

VII Compute the total allowable heat loss from the building in Btu per hour per degree of temperature difference.

VIII Analyze the design of the building to break down the total area of exposure into wall area, window area, door area, roof and/or ceiling area.

IX Assign, by trial and error, appropriate transmission coefficients for each element of the structure, being guided by the following considerations:

1 Windows will have a *U* value of 1.0 or 0.5 depending upon whether or not storm sash are used.
2 Doors will have a *U* value of 0.57, if single thickness, or 0.36, if double thickness—or other depending upon construction.
3 *U* value for the wall and ceiling should be enough lower than the value of *C* (VI above) to compensate for larger losses through windows and doors.

X Compute the total heat loss per hour per degree for all elements of the structure, except the ceiling. Subtract this amount from the total allowable heat loss (VII above) and divide the difference by the area of the ceiling. The result will be the required *U* value of the ceiling.

The following typical example involves a one-story stable to house 32 dairy cows of large breed, calling for stalls 4 ft wide. The cows face out from a central driveway. The climate is rigorous, the outside temperature dropping to −20 F for significant lengths of time during the winter. The inside minimum tolerable temperature is 50 F, requiring that insulation be adequate to protect against a temperature difference of 70 F. The design procedure is followed through in the same sequence of steps as is outlined above:

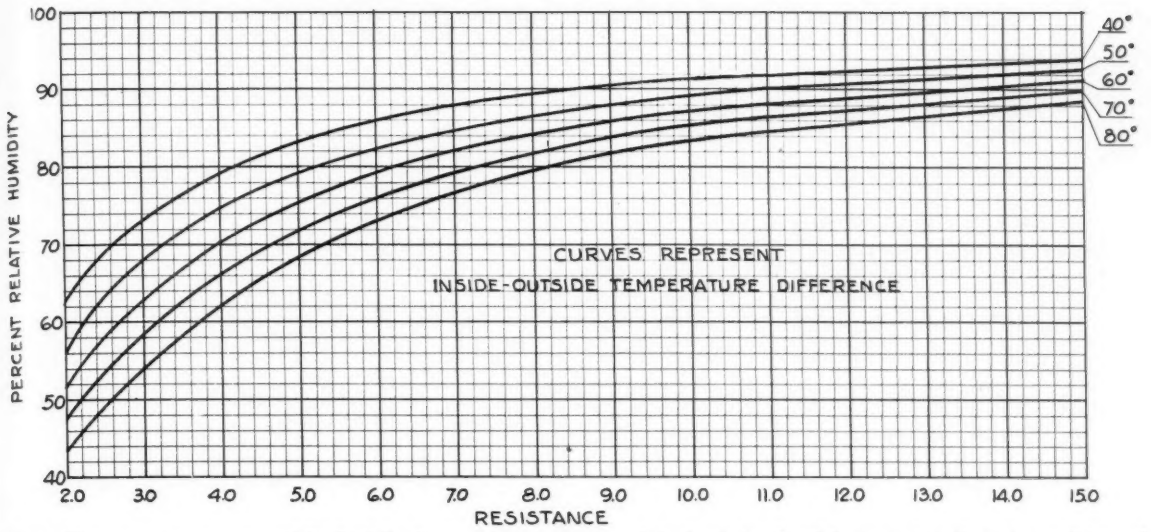


Fig. 5 These curves were prepared by Paul D. Close, technical secretary of the Insulation Board Institute, to indicate the conditions of relative humidity and resistance at which surface condensatioan will occur.

I Plan and Section (See Fig. 3).

II Total area of exposure -

Walls side	1,092 sq ft
Walls end	540 " "
Ceiling	2,808 " "
Total	4,400 " "

Area of exposure per animal unit = 4,440 ÷ 32 = 138.8 sq ft

III Design Conditions

Minimum allowable inside temperature, T	= 50 F
Temperature difference, $T-t$ or D	= 70 F
Maximum allowable relative humidity	= 75 %
Sensible heat available per hour per animal *(H)* (Fig. 2—for large cows, environmental temperature 50 F)	= 3,010 Btu
Grains H_2O produced per hour per animal *(W)* (Large cows, environmental temperature 50 F)	= 3,259 gr

IV Minimum allowable volume of air change in cubic feet per animal per hour under restricted ventilation.

$$V = \frac{W}{w} \times M \qquad [1]$$

in which V = cubic feet of air per hour per animal, restricted ventilation

W = grains of moisture produced per hour per cow

w = difference between the grains of moisture per pound in outgoing air at assumed environmental temperature and relative humidity and the grains of moisture of incoming air at outside temperature and 100 per cent relative humidity (from psychrometric tables[7])

M = cubic feet per pound of air at specified T and relative humidity (from psychrometric tables[7])

Substituting,

$$V = \frac{3{,}259}{38.2} \times 12.95 = 1{,}104 \text{ cfh per cow .}$$

Assuming incoming air to be at 100 per cent relative humidity, the most unfavorable condition, and outgoing air to be only 75 per cent saturated, it will require at least 1,104 cu ft of air per hour per cow to meet the assumed ventilating requirements, that is, to hold relative humidity in the stable down to 75 per cent without reducing inside temperature below 50 F.

V Value of AC.

The heat-balance formula $(H = VD/53 + ACD)$ proposed by the author[8] furnishes a method for relating the design of an animal shelter building to its climatic environment and to the ventilation problem. It states that heat available from the animal is all lost through a combination of air change and conduction and radiation. An algebraic transformation produces the following:

$$AC = \frac{H}{D} - \frac{V}{53} \qquad [2]$$

in which A = area of exposure per animal unit in square feet

D = Temperature difference (same as $T-t$)

V = air change in cubic feet per hour per animal unit (minimum under restricted ventilation)

53 = cubic feet of air raised 1 F by 1 Btu of heat

C = average heat-transmission coefficient (total heat loss per degree per hour ÷ total area).

Substituting,

$$AC = \frac{3{,}010}{70} - \frac{1{,}104}{53} = 22.17$$

VI Value of C.

The average transmission coefficient will be equal to $AC/A = 22.17/138.8 = 0.16$.

VII The total area of exposure is 4,440 sq ft. The average permissible heat loss per square foot per hour per degree, if relative humidity is to be maintained at 75 per cent and temperature difference is not to exceed 70 F, is 0.16 Btu. Therefore, total permissible heat loss from stable will be $4{,}440 \times 0.16 = 710.4$ Btu per hour per degree.

VIII The design calls for 3 sq ft of glass per cow and the use of storm sash. The doors will be built of two thicknesses of matched lumber with paper between. Wall height on the long sides is 7 ft and on the short ends it averages 7 ft 6 in. Areas of the various elements of the design are shown in Table 1 which includes also an analysis of heat losses.

Assume a trial coefficient for sidewalls (0.16) and set the proper coefficients for windows and doors. Compute the heat loss from the first three items and add them (324.56). Sub-

TABLE 1. DESIGN ANALYSIS

Unit	Area	C	Heat loss	
Sidewalls	1,382	.16	221.12	
Windows	96	.50	48.00	Storm sash
Doors	154	.36	55.44	
Ceiling	2,808	.137	386.70	
Total	4,440		711.26	

tract this sum from the total allowable heat loss (710.14 — 324.56 = 385.58). The difference will represent the total allowable heat loss through the ceiling. By dividing the ceiling area into this figure, the ceiling coefficient is obtained (0.137). The walls for this building should be designed from materials which will produce heat resistance of at least 1/0.16 or 6.25. The ceiling's resistance should be at least 7.3. The sections shown in Fig. 4 will satisfy this requirement.

These both have better thermal characteristics than are called for, but any other combination of similar materials of less insulating value will have less resistance than is required by the design.

Condensation Control. The ventilation design calls for moving 1104 cu ft of air through the building per animal unit per hour during extremely cold weather, an amount sufficient to hold the relative humidity down to 75 per cent. The question will be raised as to whether the inside wall and ceiling surfaces will be warm enough to prevent condensation at this humidity. This point may be checked by referring the data on heat resistance to the chart (Fig. 5), prepared by Paul D. Close, technical secretary of the Insulation Board Institute. The curves indicate maximum permissible relative humidities for any resistance and temperature difference. The temperature difference for which the wall is designed is 70 F. It is expected that relative humidity will rise to 75 per cent. By following the 75 relative-humidity line horizontally until it intersects the 70 F temperature-difference curve, and by dropping vertically from this intersection to the lower scale it is shown that the resistance to prevent condensation for these conditions is 5.7. As the resistance of the wall is 6.77 and the ceiling 8.00, these surfaces will be quite safe.

VENTILATION IS THE ONE VARIABLE FACTOR WHICH THE OPERATOR IS ABLE TO GOVERN

Ventilation Requirements. It has been stated that ventilation is the one variable factor at the disposal of the operator to enable him to regulate stable temperature. Step number IV in the computation for insulation design sets up the minimum allowable volume of air change in cold weather under restricted conditions. Obviously this will not be enough to take care of the needs when the weather moderates. It is necessary to set also the upper limits of air requirements in order to specify the maximum capacity of the ventilating system.

When outside temperature rises to the freezing point it will be difficult to maintain a constant barn temperature—at 50 F—because it will require so much air as to cause drafts. Furthermore, the equipment would be more costly than is warranted. It is reasonable though to hold a temperature difference of 30 deg and to permit the inside temperature to rise to 60 F under such mild conditions.

To determine how much air will be required to hold inside temperature down to 60 F, a second modification of the basic heat-balance formula can be used. This is

$$V = \frac{53(H - ACD)}{D}$$

in which V = the volume of air per cow per hour.

If $D = 30$ deg and inside temperature is 60 F, then substitutions in this formula may be made as follows:

$$V = \frac{53(2830 - (22.17 \times 30)}{30} = 3824.6 \text{ cu ft per cow per hour}$$

This amounts to 292.1 lb of dry air. Entering the stable at 30 F and at 100 per cent relative humidity it will bring with it 24.01 grains of moisture per pound. Inasmuch as each cow will produce 3950 grains of moisture per hour at an environmental temperature of 60 F, they will each add 13.5 grains to every pound of air requiring the outgoing air to remove 37.51 grains per pound. Inasmuch as saturated air at 60 F carries 77.21 grains per pound, the outgoing air under these mild conditions should, theoretically be at only 37.51/77.21 = 48.5 per cent relative humidity even under the most adverse circumstances.

It is to be noted that the amount of air required in mild weather will be approximately four times the minimum allowable under restricted conditions. The computed theoretical amounts are: restricted, 1104 cfh per cow; maximum, 3824 cfh per cow. It should be satisfactory to specify a fan system with a capacity of 4000 cfh per cow that can be cut down when required to as low as 1000 cfh per cow.

These computations, based upon available biological data and the heat-balance formula, produce results that check fairly closely with established practice. They indicate that a temperature difference of 70 F is not impossible to maintain; in fact, it can be held with construction that is not at all out of line with sound economics.

Similar computations for poultry laying houses show that a 50-deg temperature difference can be maintained if a fill insulation is used, but can not be if the house is merely lined on the inside with sheathing material. The method can also be applied to centralized hog houses, to indicate the amount of additional heat that may be required for any given insulation specifications when pigs are farrowed in cold winter weather. Biological data for poultry and swine are available in the publications listed in the following references as numbers 9 and 10.

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A Portable Tung Nut Decorticator

By I. F. Reed and R. E. Jezek

MEMBERS A.S.A.E.

EXPERIMENTAL work with tung in the United States started as early as 1905 when seed were received from Hankow, China, and planted at Chico, California. Seedlings from this planting were distributed to various parts of the country for testing. By 1932 approximately 30,000 acres had been planted and commercial production of tung oil in this country may be considered to have started that year when two full tank cars of oil were shipped from Gainesville, Florida. The acreage increased so that by 1944 there were 200,000 acres or more of fairly acceptable tung orchards and in addition 75,000 to 100,000 acres deemed not commercially acceptable due to neglect or having been planted in unsuitable locations. It has been estimated that this acreage produced approximately 30,400 tons of air-dried whole fruit capable of yielding over 10,000,000 lb of tung oil having a market value of about $3,500,000. This quantity is only a small per cent of the normal annual consumption. American tung oil is generally superior to that imported and thus commands a premium. It has high specific gravity, low acidity, and excellent color, thus aiding in the production of extra high-grade clear varnishes.

A very large part of the tung oil consumed in this country is used by paint and varnish manufacturers. It is used also in the production of linoleum, in certain insulating compounds for the electrical industry, in the manufacture of some automobile brake linings and gaskets on steam installations, in compounds used in the production of wallboard, in the table oilcloth industry, for water-proofing various types of fabrics, for the production of the fine carbon used in India ink, etc. Both natural and synthetic substitutes have been tried but indications are that the pure tung oil is preferred by manufacturers.

Thus the problem facing growers, processors, and research organizations dealing with tung is to develop methods and equipment that will make it possible to produce tung oil of high quality as an economic undertaking with available labor in competition with foreign oils and synthetic products. The field laboratories for tung investigations of the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, and the tung oil laboratories of the Agricultural Chemical Research Division, Bureau of Agricultural and Industrial Chemistry, are carrying on extensive research programs dealing with production of the tung fruit and extraction of the oil. The machinery problems in connection with gathering, hulling, and storing nuts are being studied at the Tillage Machinery Laboratory of the Divisions of Agricultural Engineering, Bureau of Plant Industry, Soils, and Agricultural Engineering.

The tung fruit falls from the trees over a period of six weeks to two months during the late fall. The common practice has been to allow them to lie on the ground until they dry out enough to permit storing without danger of heating. They are picked up by hand and stored in ventilated bins or sheds until dry enough for hulling and processing; then are put through a decorticator and separator unit which removes the hull and part of the shell material. The hulled nuts and shelled kernels are ground and the oil removed by an expression process.

The labor deficiency brought on by World War II definitely affected the tung growers of the United States. The handling of cover crops and the necessary tillage could be cared for with power equipment but harvesting is as yet a hand operation and requires a large amount of labor for (1) gathering the fruit in boxes or bags; (2) weighing,

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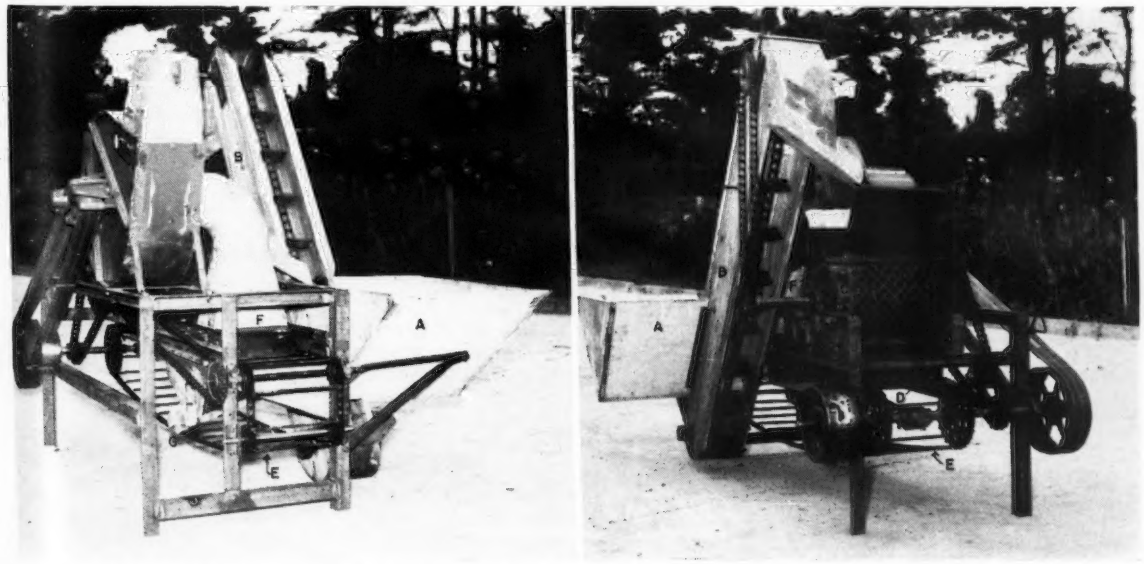

Left: Fig. 1 USDA portable tung nut huller developed for hulling moist tung fruit in the orchard at time of gathering • *Right:* The same huller with cylinder side plate removed to show cylinder construction and relation to concave

loading, hauling, and storing; (3) moving the dried fruit to the decorticator, and (4) spreading the hulls back onto the orchards for their fertilizer and mulch value. Equipment for gathering the tung fruit mechanically and for hulling the nuts in the orchard, thus reducing the material to be handled and stored, will help reduce labor requirements for the crop. Both of these problems are being studied at the USDA Tillage Machinery Laboratory, but this paper will be limited to the discussion of the decorticator or huller. The ultimate goal, however, is to develop a combination unit that gathers and hulls the crop in one operation. The hull material would then be left scattered more or less uniformly in the orchards and the nuts will be delivered to storage or to the mill with a minimum of labor.

All tung-nut hullers now available are large, stationary units and require a large amount of power. This limits them to millers or farmers having a large acreage of tung in production. The small portable tung-nut huller shown in Fig. 1 was developed to make possible hulling moist tung fruit in the orchard at the time it is gathered. Its small size makes it adaptable for use by small growers. Those having a large acreage can either use a number of machines or can arrange to have large units built incorporating the principles built into this machine. Fig. 2 shows this huller with side of the cylinder chamber removed.

The whole fruits are poured into the hopper (A) and are carried to the cylinder unit (C) by the elevator (B). The action of the cylinder unit breaks the fruit into segments and the hull loose from the nuts. This material can then pass through the concave and falls onto the shaker screen (D). Fine material passes through the front section of this shaker screen. The nuts and large pieces of hull are carried back on the shaker by chain (E) and under the aspirator (F). Larger holes in the shaker screen in this section permit the hulled nuts to fall through and be delivered to the bag or other container, but the action of the aspirator lifts the hulls and light debris and discharges them through the fan exhaust. Hulled nuts are discharged from the spout (G) to a suitable elevator to be provided. Unhulled nuts that may pass through the concave are carried over the end of the shaker screen and are discharged into the elevator (B) below the hopper, thus are returned to the cylinder.

DIMENSIONS, CONSTRUCTION, AND OPERATION OF THE CYLINDER OF THE USDA TUNG-NUT HULLER

The cylinder is 11¼ in in diameter by 14 in long and is made from a piece of 10-in steel pipe covered with canvas belting to build it to the desired diameter. Eight 1½-in angle bars are equally spaced on the circumference. The near optimum cylinder speed is 130 rpm. It is mounted on anti-friction bearings and operates within the perforated screen concave. The concave is made from 14-in hammer mill screens having ⅞-in square perforations with diagonals of the square parallel and perpendicular to the cylinder shaft. The concave is spaced 1½ to 1¾ in from the angle bars on the cylinder and forms a basket surrounding 270 deg of the cylinder circle. The action of the cylinder and concave is simple and not too severe on the nuts. When the cylinder unit is full, the rotating action of the cylinder tends to carry the whole fruit, nuts, hulls, etc., around with it and the concave tends to retard this action. This causes a rolling, milling action of one piece against another which tends to break the fruit into segments and the hulls off the nuts. The nuts, broken hulls, and small debris pass through the opening of the concave and fall onto the shaker unit. A return chute is provided so that excess nuts delivered by the elevator are returned to the hopper and a near constant pressure is maintained on the fruit being fed to the cylinder.

The shaker is operated through a link by an eccentric on the countershaft. It has ⅜-in movement and vibrates 450 to 500 strokes per minute. It is equipped with 3/16-in round-hole screen under the concave and ⅞-in round-hole screen under the aspirator. Two ⅜-in round rods equally spaced and running lengthwise to the shaker are welded to the 3/16-in section of screen. A chain with ⅜-in round cross bars spaced about 4 in apart moves slowly over the shaker from front to rear. The purpose of this chain and the round bars on the screen is to cause a relatively uniform distribution and movement on the screens, even though the huller may not be sitting level.

The fan and aspirator are located at the rear of the machine with the exhaust directed upward and to the rear. A deflector can be arranged on the exhaust to distribute the hull material as desired. The aspirator is located over the portion of the vibrating screen with the ⅞-in diameter holes. It is adjusted to a height above the screen that will permit passage of the nuts and hulls. Air passing upward through the screen into the aspirator will pick up loose hulls and light debris. The clean nuts will pass through the screen holes and are delivered to the bagging elevator. If there are some nuts with the hull left on, they cannot get through the screen but will pass off the end of the screen and into the whole fruit elevator to return again to the cylinder. The exhaust portion of the fan has a damper mounted within, which is operated by the inertia of the air leaving the fan counteracted on the outside by an adjustable spring. If the speed of the fan exceeds or falls below the normal operating speed, the damper arrangement tends to correct vacuum or suction by opening the damper if the speed drops and closing it if the speed is above normal. Thus when the speed drops, the damper opens. This offers less resistance to the flow of the air leaving the fan. The fan will tend to handle about the same amount of air even at the lower speed, so will create approximately the same vacuum in the aspirator.

THE USDA TUNG-NUT PORTABLE HULLER IS TO BE EQUIPPED WITH AN ELEVATOR

The huller shown in the accompanying figures is to be equipped with an elevator for handling the nuts. Any type arrangement can be used. Some growers have suggested that they would prefer a long elevator so as to load the nuts directly into a wagon, whereas others will use a bagging unit. It is suggested that this huller with its 8 to 10-hp engine should be mounted on a trailer so that it can be operated as it is towed through the orchard. The operator can then use his discretion as to whether to use it in that manner or to make a number of sets through the orchards.

Operation of Huller. The moisture condition of the fruit is of importance in the successful operation of this machine. If the fruit is too wet, the hull is mushy and sticky and the machine will plug and stop. When the fruit is too dry, the shell on the nut is brittle and cracking becomes excessive. The storage of cracked kernels is not desirable because the kernels become rancid and the quality of the oil is lowered. In tests of this machine, it was observed that a moisture range of about 25 to 35 per cent gave the best results.

The USDA portable huller does not need to be level to operate effectively but excessive slopes should be avoided. The countershaft should operate at approximately 500 rpm. The cylinder unit should be kept full except when planning to stop the machine. This insures uniform hulling and a partially full cylinder unit tends to increase the number of nuts cracked. The cylinder unit should be permitted to run empty before stopping the machine or it will be difficult to start. Adjustment of the *(Continued on page 420)*

A New Method of Steel Fabrication for Farm Building Frames

By Stanley A. Witzel
MEMBER A.S.A.E

A NEW system of steel fabrication has been developed as a part of the dairy barn research project being carried out cooperatively between the University of Wisconsin and the Carnegie-Illinois Steel Corporation. The development provides a new method of steel fabrication for all types of farm-building frames and may be adapted for even the shells of such structures as silos. An experimental site-welded silo is now being constructed from flat-steel sheets. Coming at a time when all competing types of framing materials are expensive and scarce, the quickly erected and moderately priced site-welded steel frame can go a long way in helping to meet the unprecedented demand for new farm buildings at this time.

The development of the site-weld system was the result of an effort to get an addition built during wartime to the Wisconsin research dairy barn which is housing dairy cows for a study of the effect of housing environment on the cows. Official approval was secured for a limited amount of steel and the steel was located, a little here and a little there in warehouses throughout the country. Fabrication shops were all tied up on war work. Still there was a critical building to fabricate and erect at the earliest possible date.

After considering the possibility of setting up a fabrication plant in a corner of the barn for drilling and bolting the trusses, the idea of welding up the truss on the site was carefully considered. The idea seemed sound, the cost seemed reasonable, and to satisfy the skeptics time records were kept and compared with two bolted trusses built for comparison.

Building the Trusses. A simple framework of 2x4-in stakes and crosspieces carefully leveled provided the worktable for the fabrication of the trusses. Built to the proper height the welder could stand comfortably and use his cutting flame or arc-welding equipment. The stock piles were located nearby with each length of steel angle piled separately. There was walking space all around the work table; in fact, since there was no solid top the welder could stand on the ground anywhere and weld at the level of the table by simply stepping over his 2x4 framework.

The steel angles were easily laid in place against blocks and nails set to conform to a simple line drawing which the welder had to work from. Exact rivet locations or bolt holes were not needed and all of the time required to locate them according to plans was saved. The steel angles were easily picked up from the stock pile, placed on the table and arc-welded with a portable welding unit by one man. The trusses were even light enough so he could slide them off the table and stand them up after they were built.

The time required to build 10 electric-welded roof trusses with a 25-ft span averaged 2 man-hours per truss, with one truss being built in 65 min after the operation was well organized. Two bolted trusses required 10½ man-hours per truss. An experienced welder should be able to weld these trusses in such a way that the full strength of the steel members can be developed as is the aim in riveted or bolted construction.

The time required to site-fabricate bolted steel trusses as against the site-welded trusses demonstrates the impracticability of site-fabricating bolted trusses; however, the site assembling of fabricated bolted trusses is probably competitive in cost with site welding. (More research must be done to prove the economics of each and the proper application of these two methods of construction for farm building frames.)

Since the entire supporting framework was to be of steel the following time data was obtained on electric-welded construction:

22 steel columns fabricated at 18 man-min per column
6 steel door jambs fabricated at 2 man-min per jamb
10 steel roof trusses fabricated at 2 man-hr per truss
29 steel studs fabricated at 9½ man-min per stud.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

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A front view of foreground structures on the University of Wisconsin dairy barn research project. The small flat-roofed building in the foreground is the milk house. It is built of galvanized sheet steel panels; the siding, the inside walls and ceiling sheets are load-bearing panels. The roof is built up from insulation board, roofing paper, tar, and gravel

Erection of the Framework. After fabricating the trusses and other parts of the structure they were erected and welded in place to form a completely welded structure of rigid construction. Time records were kept on erection as well as fabrication and were as follows:

The erection of the columns, top angles, 16-gauge studs, bottom angles, struts, and wind braces for the L-shaped building 25 by 60 ft and 25 by 48 ft by the electric site-weld method was 60 man-hours for the welder and 28 man-hours for his helper, or a total of 88 man-hours.

The time required for the erection of the 10 electric welded trusses and electric welding in place with one purlin at the top and one purlin at each bottom required 8 man-hours for the welder and 16 man-hours for his helpers. A Jim-pole and hand winch was used to lift trusses into place.

The time required to erect and weld in place the remainder of the purlins was 8 man-hours for the welder and 12 man-hours for his helpers.

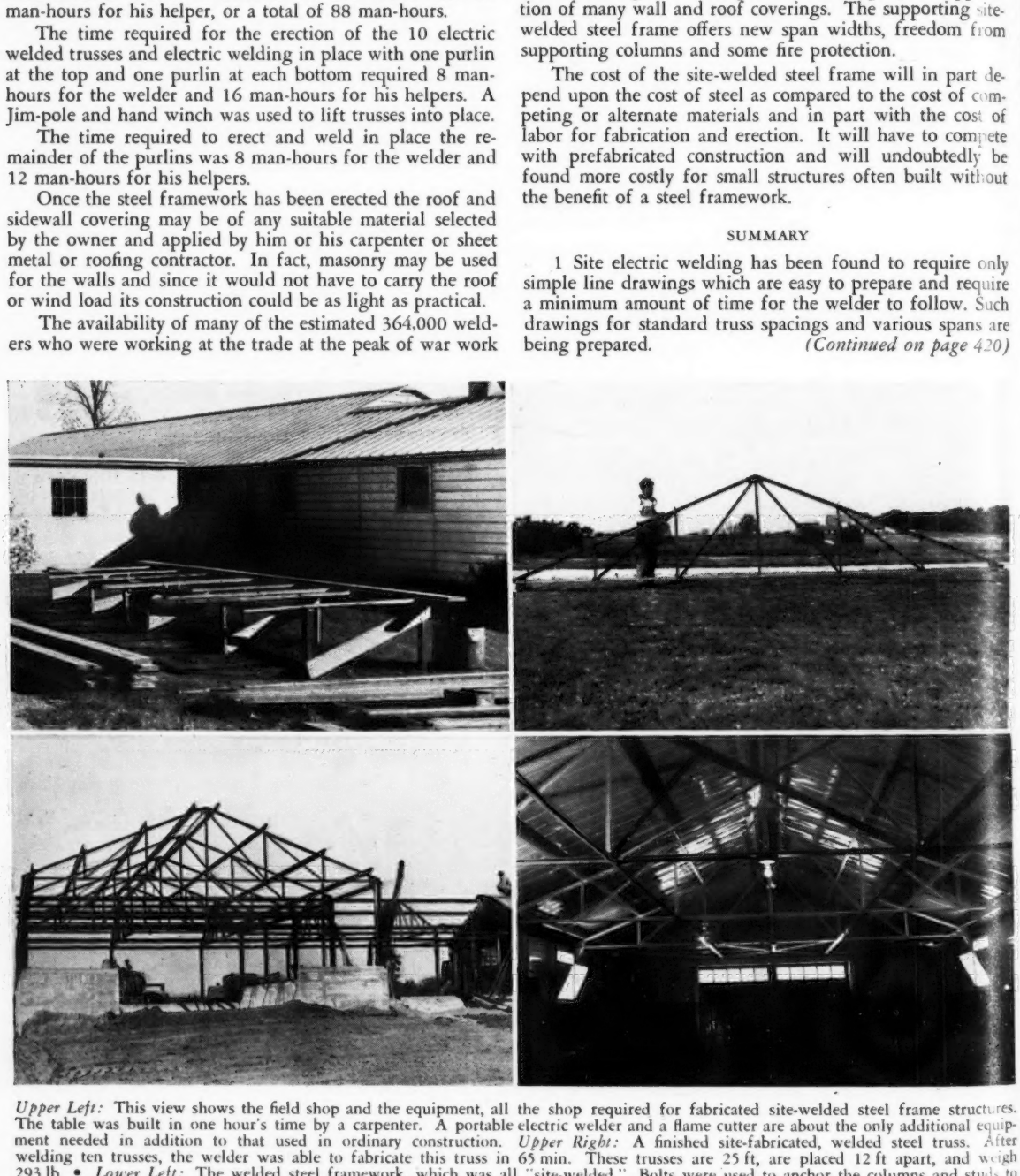
Once the steel framework has been erected the roof and sidewall covering may be of any suitable material selected by the owner and applied by him or his carpenter or sheet metal or roofing contractor. In fact, masonry may be used for the walls and since it would not have to carry the roof or wind load its construction could be as light as practical.

The availability of many of the estimated 364,000 welders who were working at the trade at the peak of war work plus those trained in the armed services will provide trained man power perhaps equal in numbers to the estimated 427,000 carpenters employed in the United States. With a simple set of line drawings and a small stock of light angles and gusset plates these welders, with the use of portable electric-welding units and a gas cutting torch can fabricate a steel framework for any farm building. Perhaps the simple gable-roof truss will be easiest to start on and no doubt wood studding and wood purlins will simplify the application of many wall and roof coverings. The supporting site-welded steel frame offers new span widths, freedom from supporting columns and some fire protection.

The cost of the site-welded steel frame will in part depend upon the cost of steel as compared to the cost of competing or alternate materials and in part with the cost of labor for fabrication and erection. It will have to compete with prefabricated construction and will undoubtedly be found more costly for small structures often built without the benefit of a steel framework.

SUMMARY

1 Site electric welding has been found to require only simple line drawings which are easy to prepare and require a minimum amount of time for the welder to follow. Such drawings for standard truss spacings and various spans are being prepared. *(Continued on page 420)*



Upper Left: This view shows the field shop and the equipment, all the shop required for fabricated site-welded steel frame structures. The table was built in one hour's time by a carpenter. A portable electric welder and a flame cutter are about the only additional equipment needed in addition to that used in ordinary construction. *Upper Right:* A finished site-fabricated, welded steel truss. After welding ten trusses, the welder was able to fabricate this truss in 65 min. These trusses are 25 ft, are placed 12 ft apart, and weigh 293 lb • *Lower Left:* The welded steel framework, which was all "site-welded." Bolts were used to anchor the columns and studs to the foundation. Part of the materials used in the frame were precut and part of it side-cut from standard mill lengths. No other prefabrication had been done. It now appears that site or local shop cutting of materials may be very practical for this system of construction • *Lower Right:* Finished and painted site-welded steel frame building. Note the neat appearance of the trusses

Performance of Grain Bin Floors

By E. R. Gross
FELLOW A.S.A.E.

THE floor of a grain bin is a vulnerable point because it not only supports the load but must keep the grain dry at the place where moisture accumulation is quite likely. Here it is necessary to guard against moisture from the earth if the bin floor rests directly upon the ground, the splash from dripping eaves, water running down the walls, the concentration of moisture within the grain mass due to temperature changes or insect activity, and even moisture from wall or roof leaks which moves downward through the grain and comes to rest at the floor.

A study of floor types in bins filled with wheat was undertaken in June, 1941, at the Hutchinson, Kansas, bin site of the Commodity Credit Corporation in cooperation with the Bureau of Entomology and Plant Quarantine and the Kansas Agricultural Experiment Station*. The scope of the project developed with its progress, so that with the May, 1944, unloading of bins evidence had been collected in 30 bins representing 19 floor types, ten of which were tested 3 times, five twice and four only once. Tests ran from 12 to 35 months, a total of approximately 89 bin years. Number and length of tests for each floor type are indicated under "Years Run" in Table 2. At the conclusion of each test the bin was emptied to permit complete examination and sampling of the grain in the various locations. Particular attention was paid to the condition of the floor and the grain immediately above it and to evidences of leakage through roof, wall, or the floor-wall joint.

Originally 26 corrugated steel bins of 1000-bu capacity, 14 ft in diameter by 8 ft high, were set up in pairs representing 13 floors differing in type of construction and materials used. At this time the number of floor types and the extent of replication was limited by the number of bins available. During the year, as bins were released from other studies, four bins representing two additional floor types were added, bringing the total to 30 bins and 15 floor types. In April, 1943, after standing about two years, 15 bins, one of each of the pairs, were emptied. The bins thus emptied were refilled and changes made in some of the floors because the findings indicated that study beyond the check bin was not necessary. Thus four new floors were added bringing the total to 19 types. For causes not related to the floor one bin was removed from the project soon after the 1943 refilling. The remaining 29 bins were emptied in May, 1944.

Weather during much of this period was unusually wet, as indicated in Table 1. Water frequently stood on the bin site, with the water level only 6 to 8 in below the grain level. Note the heavy precipitation in April and May, 1944, before and during the final period when the floor examinations were made.

The wheat used in these floor tests was from the 1940 crop and was of uniform quality and moisture content. Insects were controlled by fumigating twice annually, in August and October. Quality of the grain as indicated by grade classification was maintained satisfactorily.

The available data include grade factors when the grain entered the bins, periodic average bin samples for grade, special samples for moisture at the floor (center, north and south); and at the time of emptying, average bin samples for grade and moisture samples at the floor.

TABLE 1. PRECIPITATION AT HUTCHINSON, KANSAS
June, 1941, to May, 1944

	1941	1942	1943	1944	40-year average
January		0.35	0.20	0.65	0.68
February		1.29	1.03	1.43	1.10
March		1.65	0.81	3.49	1.51
April		6.63	1.27	9.72	2.41
May		1.21	3.42	5.43	4.63
June	9.44	10.78	3.42		3.87
July	3.64	2.90	4.30		2.95
August	3.19	4.90	3.40		3.04
September	3.86	8.39	2.59		3.00
October	6.41	5.58	3.37		2.01
November	0.82	0.77	0.15		1.61
December	1.01	2.30	2.60		0.79
Yearly	38.96	46.75	26.56		27.60

Floor Types. A description of the floor types used will be helpful. For convenience each is given an abbreviated title.

1 Steel on earth, floor-wall joint not caulked. A conventional steel floor placed on an earth fill.

2 Steel on earth, floor-wall joint caulked. Same as 1, except the floor-wall joint was caulked.

3 Steel on gravel. Same as 2, except a gravel fill was used.

4 Steel on tile. A conventional steel floor placed on hollow clay tile building blocks laid contiguously to form a platform 3 in thick and approximately circular in shape. The tile was so laid as to provide air circulation beneath the floor through the hollow spaces in the tile.

5 Steel on joists. A steel floor supported by 2x4-in floor

Fig. 1 Bins used for floor investigations in the USDA studies at Hutchinson, Kans., were all 1000-bu galvanized steel bins. The concrete-block foundation shown was used with all floors, except in case of the bins with monolithic concrete floors and foundations

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

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*This study was begun under the direction of Dr. H. J. Barre, former agent in charge, grain storage investigations, Division of Farm Structures Research, Bureau of Agricultural Chemistry and Engineering, and now head, department of agricultural engineering, Purdue University. The former Division of Farm Structures Research, Bureau of Agricultural Chemistry and Engineering, is now the Division of Farm Buildings and Rural Housing, Bureau of Plant Industry, Soils, and Agricultural Engineering. W. R. Swanson was in charge of the project at Hutchinson, Kansas, prior to June, 1943.

joists spaced 6 in o. c., set on concrete blocks, allowing free circulation of air beneath.

6 Perforated steel. Same as 5, except the floor was perforated sheet steel.

7 Concrete on earth. A 4-in reinforced concrete slab cast as a unit on an earth fill with a 6-in foundation ring extending 10 in below grade; the bin walls rest upon the floor.

8 Concrete, one coat asphalt. Same as 7, except one coat of emulsified asphalt was applied to the floor surface to form a moisture barrier.

9 Concrete, two coats of asphalt. Same as 8, except two coats of emulsified asphalt were used.

10 Concrete, board overlay. Same as 7, except an overlay of 1-in boards was placed on the concrete.

11 Concrete, aluminum foil, boards. Same as 10, except aluminum-foil paper was used under the boards.

12 Concrete, aluminum-foil overlay. Same as 7, except an aluminum-foil paper overlay was placed on the concrete floor.

13 Concrete on gravel. Same as 7, except the concrete floor was placed on a 6-in gravel fill.

14 Concrete, roll-roofing overlay. Same as 13, except an overlay of roll roofing with laps cemented was placed over the concrete floor.

15 Concrete on tile. A 4-in reinforced concrete slab placed on a tile block platform, as in 4, with asphalt-saturated felt between the concrete and tile.

TABLE 2. EXTENT OF SPOILAGE IN WHEAT STORED IN STEEL BINS WITH DIFFERENT TYPES OF FLOORS

Type of Floor	Years run	Year emptied	Floor spoilage bu*	Other spoilage Amount, bu	Cause	
Double board	1	1944	None	Trace		W
	2	1943	None	None		
	3	1944	None	3.5		W
Steel on earth, not caulked	2	1943	None	10.0	FW	
	3	1944	None	8.0	FW	W
Concrete, roll-roofing overlay	1	1944	None	None		
Steel on gravel	1	1944	None	0.5		W
	2	1943	None	None		
	3	1944	None	10.00		W
Steel on joists	1	1944	None	0.25		W
	2	1943	None	None		
	3	1944	None	1.5		W
Single board	1	1944	None	1.5		W
	2	1943	None	None		
	3	1944	None	0.5		W
Concrete, aluminum-foil overlay	2	1943	None	Trace	FW	
	3	1944	None	2.0	FW	
Roll roofing on earth	1	1944	None	1.5	FW	W
Steel on earth, caulked	2	1943	None	None		
	3	1944	None	Trace	FW	
Steel on tile	1	1944	None	1.0	FW	
	2	1943	None	Trace	FW	
	3	1944	None	1.5	FW	
Perforated steel	1	1944	None	Trace		W
	2	1943	None	None		
	3	1944	None	None		
Two-course concrete	1	1944	None	Trace	FW	W
	2	1943	None	None		
	3	1944	None	1.5		W
Concrete, aluminum foil, boards	1	1944	None	Trace		W
	2	1943	None	None		
	3	1944	None	1.5	FW	W
Concrete on gravel	2	1943	10.0	?	FW	
	3	1944	9.0	?	FW	W
Concrete on tile	1	1944	2.5	?	FW	W
	2	1943	12.0	?	FW	
	3	1944	8.0	?	FW	W
Concrete, two coats asphalt	1	1944	None	1.5	FW	
Concrete, one coat asphalt	1	1944	None	2.0	FW	
Concrete on earth	2	1943	20.0	None		
	3	1944	10.0	5.0	FW	
Concrete board overlay	1	1944	1.0	1.0	FW	
	2	1943	30.0	10.0	FW	
	3	1944	8.0	5.0	FW	

*Spoilage figures are estimated not measured quantities.

FW indicates floor-wall leak; W, wall leak.

? indicates that spoilage could not be apportioned, total is given in floor column.

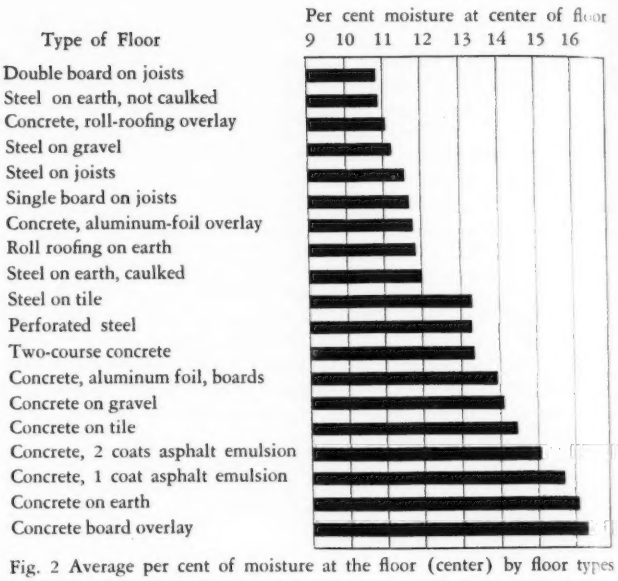

Fig. 2 Average per cent of moisture at the floor (center) by floor types

16 Two-course concrete. Concrete floor, as in 7, except cast in two courses, the first course being smooth troweled and mopped with hot asphalt before placing the finishing course.

17 Single board. A floor of 1-in matched flooring placed on joists as in 5.

18 Double board. A 1-in subfloor, building paper and 1-in finished floor on joists as in 5.

19 Roll roofing. One layer of roll roofing, laps cemented, placed on an earth fill.

All floor fills were surrounded by a ring of concrete blocks laid without mortar and encompassed by a No. 9 wire. The wall sheets in some instances rested upon the flooring material. This was true for all concrete floors, the roll-roofing overlay on concrete, roll roofing on earth, and aluminum-foil paper with and without the board overlay. All board overlays on concrete floors were fitted inside the bin walls. Caulking compound was applied to all bolts, wall seams and floor-wall joints during construction operations except as otherwise noted. The considerable number of leaks found indicates that the caulking was not fully effective, hence the suggestion under the subheading "Observations Concerning Steel Bins" later in this paper.

RESULTS OF THE TRIALS

The determining factors in these investigations were (1) the presence of spoiled grain on the floors and (2) the moisture content of the grain in the 3-in layer at the floor. Although disturbing factors were eliminated as much as possible, wall and floor-wall joint leaks made it necessary to discriminate carefully. Using data from the center of the floor only separated the effect of leaks quite satisfactorily. There was no evidence that any of the few roof leaks penetrated to the floor. The data on bin emptyings are recorded in Table 2 showing duration of trials, year emptied, amount of spoiled grain and the cause of spoilage. The data on moisture are found in Table 3 giving the bin average, the percentage at the floor center and the average for each floor type. Fig. 2 is a graphic representation of these type averages grouped in ascending order. Fig. 3 illustrates caked grain found on certain floor types.

Spoilage at the Floor. Early in the 1944 emptyings a characteristic difference was noted between spoilage from

leaks and that attributed to conditions at the floor. Floor spoilage, the result of excess moisture in vapor form, causes moldy caked grain of a gray color. Water from leaks usually causes rot surrounded by a firmer pack of moldy grain with a more definite line of demarcation. It is noted in Table 2 that spoilage due to the floor occurred in ten bins comprising all bins of four floor types: (1) concrete on earth, (2) concrete on gravel, (3) concrete with board overlay, (4) concrete on tile. None of these have a moisture barrier. Apparently boards furnish very uncertain protection in this line. Concrete on tile must be considered with reservations on account of a construction feature which proved faulty, as explained later.

High Moisture at the Floor. Fig. 2 indicates the ranking of the various floors based on average moisture contents in the lower 3 in of grain when the bins were emptied; Table 3 gives data for the individual bins. The maximum safe moisture content may be taken as 13 per cent, since experience indicates that more than 13 per cent moisture ultimately would result in spoilage. On this basis the floors may be divided into three groups. The first nine types had no bin with more than 13 per cent moisture content in the lower 3 in of grain, and may be considered safe. All bins of the last six types had 14 per cent or more moisture in the lower 3 in of grain and are considered unsuitable for grain storage. Each of the remaining types had one or more bins with more than 13 per cent moisture in the lower 3 in of grain and must be classed as doubtful. Some additional comment on them is in order:

The two steel-on-tile floors unloaded in 1944 undoubtedly were at a disadvantage due to tilting of the outside rows of tile and the heavy rains occurring just previous to the emptying of the bins.

Perforated steel floors should be satisfactory in dry seasons. The moisture in the grain above such a floor is known to fluctuate. The 1944 emptyings were made following a period of high precipitation.

The average for the two-course concrete floors was raised above 13 per cent by one of the 1944 emptyings. Had there been no leakage at the floor-wall joint the condition of high moisture might not have existed.

There is no explanation why aluminum foil paper with boards should not be as effective as without the boards. Here again the group is thrown out by one bin of 1944 emptying.

Moisture samples taken in 1943 from the four types

Fig. 3 Caked grain on a concrete floor with board overlay. Note that the grain to the right of the hand did not roll freely. It is moldy and caked but not decayed. This condition was found on all concrete floors without moisture barrier

TABLE 3. MOISTURE CONTENTS OF WHEAT STORED IN STEEL BINS WITH DIFFERENT TYPES OF FLOORS

Type of floor	Bin average %	Average periodic samples %*	AT THE FLOOR At emptying 0 to 3-in. level, % April, 1943	May, 1944	Type average for 1943 and 1944 %
Double board	11.19	11.10	11.6	.....	.....
	11.14	.....	.....	11.2	.....
	11.23	10.80	.....	9.8	10.87
Steel on earth, not caulked	11.48	11.17	.....	10.5	.....
	11.22	11.13	11.3	.....	10.90
Concrete, roll-roofing overlay	11.46	.....	.....	11.1	11.10
Steel on gravel	11.43	11.10	.....	11.2	.....
	11.31	11.30	11.5	.....	.....
	11.40	.....	.....	11.4	11.30
Steel on joists	11.30	11.27	11.1	.....	.....
	12.33	.....	.....	10.8	.....
	11.28	11.03	.....	13.0	11.65
Single board	11.32	11.90	13.0	.....	.....
	11.38	.....	.....	10.2	.....
	11.18	11.63	.....	11.8	11.67
Concrete, aluminum-foil overlay	11.11	10.83	.....	12.9	.....
	11.02	11.05	10.8	.....	11.85
Roll roofing on earth	11.48	.....	.....	11.9	11.90
Steel on earth, caulked	11.37	11.40	.....	12.9	.....
	11.32	11.15	11.1	.....	12.00
Steel on tile	11.33	11.17	.....	15.5	.....
	11.56	11.37	11.3	.....	.....
	11.32	.....	.....	13.3	13.37
Perforated steel	12.38	11.75	.....	13.7	.....
	12.41	.....	12.6	.....	.....
	11.46	.....	.....	13.8	13.37
Two-course concrete	11.39	11.50	12.4	.....	.....
	11.42	.....	.....	15.4	.....
	11.73	11.70	.....	12.4	13.40
Concrete, aluminum foil, boards	11.24	11.13	12.5	.....	.....
	11.50	.....	.....	17.3	.....
	11.59	11.37	.....	12.1	13.97
Concrete on gravel	11.58	11.70	14.3	.....	.....
	11.43	11.30	.....	14.1	14.20
Concrete on tile	11.38	11.90	.....	15.0	.....
	11.24	11.20	14.5	.....	.....
	11.34	.....	.....	14.1	14.53
Concrete, two coats asphalt	11.54	.....	.....	15.1	15.10
Concrete, one coat asphalt	11.46	.....	.....	15.8	15.80
Concrete on earth	11.42	11.75	15.8	.....	.....
	11.51	11.73	.....	16.5	16.15
Concrete, board overlay	11.26	11.93	.....	17.7	.....
	11.40	11.80	17.0	.....	.....
	11.38	.....	.....	14.5	16.40

* The periodic samples, taken with the bottom cell of a divided probe inserted vertically, represent a slightly higher level than the samples at emptying.

just enumerated were all lower than 13 per cent, probably due to a drier season.

Since the two bins with one and two coats of emulsified asphalt were very high in moisture at the floor, the type is extremely doubtful. Probably the asphalt coatings were not vaporproof.

The type, concrete on tile, was at a definite disadvantage since the tile block platform was not completely covered by the circular floor. Hence blocks extending beyond the concrete when subjected to the load were tilted toward the bin. Water thus collected on the asphalt-saturated felt forming the moisture barrier could not escape and was absorbed by the floor. Both spoilage and high moisture was found in each of the three trials.

CONCLUSIONS

In these investigations nine floor types proved effective in that no spoiled grain was found on the floors and floor moisture was adjudged to be within safe limits: (1) steel on earth, not caulked; (2) steel on earth, caulked; (3) steel on gravel; (4) steel on joists; (5) concrete with aluminum-foil overlay; (6) concrete, roll-roofing overlay; (7) single boards on joists; (8) double boards on joists, and (9) roll roofing on earth.

Six floor types failed in that spoiled grain was found, or excessive moisture developed near the floor, or both con-

ditions prevailed: (1) concrete on earth, (2) concrete on gravel, (3) concrete with board overlay, (4) concrete on tile (5) concrete with one coat of emulsified asphalt, and (6) concrete with two coats of emulsified asphalt.

Four types are uncertain in that no spoilage occurred but moisture was excessive in at least one trial: (1) steel on tile, (2) perforated steel on joists, (3) two-course concrete, and (4) concrete wiht aluminum-foil paper and board overlay.

SOME OBSERVATIONS CONCERNING THE PERFORMANCE OF STEEL GRAIN BINS

It has sometimes been assumed that the floor is the most vulnerable point of a grain bin. The comparatively large amount of spoiled grain in these bins due to leaks controverts this assertion. Practically every bin developed spoilage due to one or all of the common leaks at door jambs, wall and roof seams or the floor-wall joint. It must be assumed that an effective floor type includes a waterproof junction between floor and wall. The most certain form is a construction in which the wall sheet extends below the level of the floor. It is important that the floor be elevated enough to exclude surface water. Caulking between sheets during construction with a compound or with prefabricated gaskets, in conjunction with uniformly tightened bolts is the suggested remedy for wall and roof leaks. A tension wrench might be desirable.

Roof clips should be designed to attach outside of the bin wall and be shaped to extend downward with the slope of the eaves rather than upward toward the apex of the roof.

The steel floors were given a 4-in crown at the center of the bin to allow for settling of the fill and provide drainage toward the edge of the floor. This did not prevent spoilage in the grain and no advantage is attributed to the feature.

SUMMARY

Nineteen floor types were tested. Three general types of floors are effective as follows: (1) Floors supported on joists with free air circulation beneath, flooring materials used being single boards, double boards with paper between and sheet steel, (2) sheet steel on a fill of earth or gravel, and (3) concrete with positive moisture barrier. Barriers used were roll roofing and aluminum-foil paper; both scuff easily.

There is one good temporary floor, roll roofing, laps cemented, on an earth fill.

Three general types failed: (1) Concrete, without moisture barrier, on earth or gravel fill, (2) concrete with a board overlay, and (3) concrete surfaced with either one or two coats of emulsified asphalt.

There is insufficient data to judge finally the effectiveness of two types: (1) two-course concrete with an asphalt membrane between, and (2) concrete with an overlay of aluminum-foil paper and boards.

A Tung Nut Decorticator

(Continued from page 414)

aspirator flaps and fan exhaust varies the tendency to lift hulls, nuts, etc. They can be set to take out nearly all of the debris without loss of more than about ½ to 1 per cent of the nuts. Much of this loss is made up of immature nuts that have been found to be low in the percentage of oil. The hulls may be distributed as desired by use of a deflector.

The capacity of whole fruit is 1,500 to 2,000 lb per hr. A composite analysis of the nuts from the huller made by J. Howard Ellison, junior pomologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, gave the following results:

	Per cent
Whole nuts	92.25
Cracked nuts	4.83
Nuts with inner hull attached	0.65
Whole kernels	1.46
Cracked kernels	0.12
Outer hulls	0.41
Inner hulls	0.04
Shells	0.08
Debris	0.16

SUMMARY

The USDA portable tung nut huller described in this paper does the job effectively and efficiently. It is simple in its construction and operation and can be made in sizes adaptable for use in large and small orchards. It cracks a lower percentage of the nuts than available commercial hullers and tests indicate that the nuts from this huller can be milled effectively without recleaning. It has the following advantages:

1 Hulls are removed and scattered in the orchard, thus saving handling, hauling, and storage space.

2 It makes starting of milling operations possible earlier as hulled nuts should dry more rapidly than whole fruit. This will make it possible for a mill to serve a larger acreage.

3 It makes it possible for each grower to hull his own crop and thus keep the hulls on his orchard for their mulch and fertilizer value.

AUTHORS' NOTE: The authors wish to acknowledge the assistance and suggestions of Dr. R. S. McKinney and staff of the tung oil laboratories, Agricultural Chemical Research Division, Bureau of Agricultural and Industrial Chemistry, the work done by Dr. O. A. Brown, who was at the tillage machinery laboratory of the Bureau of Plant Industry, Soils, and Agricultural Engineering until March 1944, and the timely suggestions of J. W. Miller and A. G. Marsh of the Tillage Machinery Laboratory staff who helped throughout with the development and testing of the huller.

New Method of Steel Fabrication for Farm Building Frames

(Continued from page 416)

2 Site electric welding of farm building frames can be done with a surprisingly small amount of labor.

3 Small angles and other steel shapes cut to length can be secured direct from the steel warehouse. They are easy to ship and the cost is low.

4 Farm-building designers have greater freedom in selecting economical spans and greater framing flexibility.

5 Electric welders interested in following their trade can follow the concrete contractor quickly, erect the steel framework for farm buildings, and let the next crew apply wall and roof coverings. The equipment is moderate in cost, the work is not difficult to do, and a limited stock of small angles and other steel shapes will enable him to supply within a very few days the complete electric-welded frame work for any steel building. Standard plans can be referred to for estimates and laying out the work.

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Some Engineering Aspects of Blanching Cut Fruits for Dehydration

By R. L. Perry, G. L. Marsh, and H. J. Phaff
MEMBER A.S.A.E.

STEAM blanching of cut fruits prior to sulfuring has been shown* to result in a dehydrated product of superior translucent appearance which resembles sun-dried fruit. The drying time is appreciably shortened by blanching. Thus a procedure for avoiding the sanitary hazards of the dry yard is available.

Blanching requires a blancher and a boiler. For apricots, the continuous type seems to have several advantages over the cabinet or batch type. For fruit which is to be blanched a longer time, cabinet blanchers may be used.

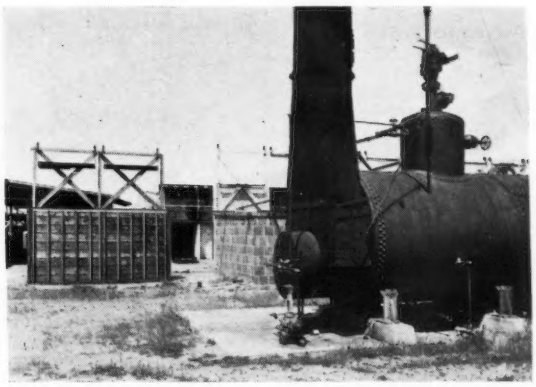

Fig. 1 Boiler and cabinet blancher for cut fruit dehydration

In Fig. 1, two single-car blancher cabinets can be seen beside the sulfur houses, beyond the boiler. It is important to have the equipment properly built and operated, and of a size which fits in with the rest of the plant operations. If these points are not observed, the results may be poor, giving a product which will not meet government specifications nor find a premium civilian market, and the operating costs may be excessive.

When cut fruit is at first exposed to steam at atmospheric pressure, the surface rises very rapidly in temperature. The temperature of the center does not change at first, but as heat penetrates it begins to rise and soon approaches that of the surface. In large cling peaches, the surface will reach 170 F (degrees Fahrenheit) in 2 min, and 200 F in 7 min. The center will rise to 100 F in 2 min, to 150 F in 5 min, to 170 F in 7 min, and to 200 F in 11 min. Typical blanching temperatures are shown in Fig. 2 from a test of a single-car cabinet blanching freestone peaches, with an ample steam supply.

With a continuous blancher, where the trays of fruit are carried through a long steam-filled box on conveyor chains each tray of fruit receives similar treatment, so that once the time required for the variety and size of fruit has been established, uniform results can be secured with a minimum of attention from the operator.

For good performance, the temperature should be above 200 F within one-fourth the length of the blancher from the feeding end. In order to do this, the steam distributing system should be arranged to provide the steam where it is needed. The tray inlet and discharge slots should be baffled to a minimum clearance to reduce the amount of air which enters and the amount of steam lost. If air is mixed with steam in the box, the temperature cannot be brought to 212 F and the presence of air interferes with transmission of heat from steam to the fruit. The vent hoods at each end of the box should not be directly connected to the box lest draft through one of them draw air into the box through the other end.

The steam requirement, expressed as developed boiler horsepower (one developed boiler horsepower is roughly equal to the conversion of 30 lb of water into steam per hour) can be found for a continuous blancher as follows:

$$\text{DBHP} = \frac{\text{Pounds of fruit per hour} \times \text{temperature rise of the fruit}}{33{,}500 \times \text{blancher thermal efficiency (as a decimal fraction)}}$$

The temperature rise of apricots will be from about 70 F to 180 F, while cling peaches will be heated over 200 F. It is not safe to estimate continuous blancher efficiency at over 35 per cent, although better performance may be secured with good baffling, air exclusion, and control of steam wastage. Thus blanching 144 trays of apricots per hour, with a tray load of 35 lb per tray, the boiler horsepower will be

$$\frac{35 \times 144 \times (180 - 70)}{33{,}500 \times 0.35}, \text{ or } 47 \text{ boiler hp.}$$

If there were no other load in the plant, this might be carried by a boiler rated at 40 hp, developing 18 per cent more than its rating. However, steam is helpful for other operations, and a 50-hp boiler would be desirable.

About 85 per cent of the heat absorbed by the fruit is gained in the first half of the blancher. The area of the steam pipe openings should be about in proportion to this, and the pipes should be assembled in two sections, each with its own valve, in order to adjust the steam rate in each half to provide the desired temperature without waste of

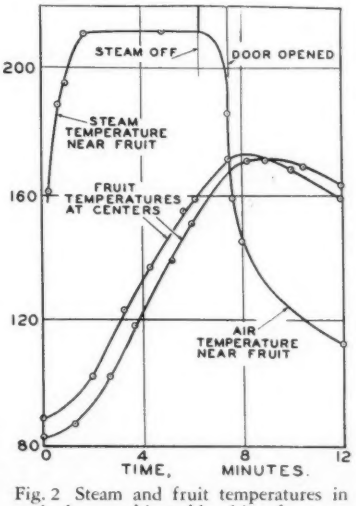

Fig. 2 Steam and fruit temperatures in a single-car cabinet, blanching freestone peaches.

This paper, presented at the University of California "Dehydration Conference for Grapes and Cut Fruits," held at Modesto, Calif., May 1, 1945, reports on a joint research project of the Quartermaster General's Office, U. S. Army, and the University of California.

R. L. PERRY is a staff member of the Division of Agricultural Engineering and G. L. Marsh and H. J. Phaff are staff members of the Division of Food Technology, University of California.

*"New Methods Produce Superior Dehydrated Cut Fruits," Part I, H. J. Phaff, R. L. Perry and E. M. Mrak. Food Industries, Vol. 17, No. 2, pp. 150-153, February, 1945. Part II, H. J. Phaff, G. L. Marsh, E. M. Mrak and C. D. Fisher. Food Industries, Vol. 17, No. 5, pp. 516-518, May, 1945. Part III, H. J. Phaff, E. M. Mrak, R. L. Perry and C. D. Fisher. Food Industries, Vol. 17, No. 6, pp. 84-87, June, 1945.

steam. Some steam will of course be lost at each end of the box, for enough must be supplied to keep the box slightly above atmospheric pressure in order to sweep out air which tends to be carried in with the fruit.

For convenience in proportioning the steam-pipe openings, the rate at which steam will flow through each square inch of drilled-hole area into the atmosphere is given in Table 1.

TABLE 1. RATE OF STEAM FLOW PER SQUARE INCH OF ORIFICE AREA

Gauge pressure, lb per sq in	Steam rate, lb per hr	Equivalent developed boiler horsepower
1	270	9
2	375	12.5
4	540	18
6	630	21
8	690	23
10	780	26
15	900	30
20	1050	35
30	1350	45
40	1650	55
50	1950	65
60	2250	75
80	2850	95
100	3450	115

For a case where the boiler pressure is 40 lb per sq in, the pressure in the manifold might be estimated as 30 lb per sq in because of a drop of 10 lb per sq in in friction loss through line and valve. With the load calculated in the example given above, the area of the holes must be 47/45 or 1.04 sq in. If 3/32-in holes are drilled (each having an area of 0.0069 sq in), the number needed is 1.04/0.0069, or 150. Of these 85 per cent, or about 125, will be needed in the first half of the box, and the remainder in the second half.

The blancher length can be predicted from the formula given by Phaff*, as follows:

$$\text{Blancher length} = \frac{C \times W \times t}{L \times 2 \times 60}$$

in which C = capacity, pounds of fruit per hour
W = tray width in direction of travel, in feet
t = blanching time, in minutes
L = tray load, in pounds of fruit

This formula is based upon double decking of trays in the blancher, a practice which was found feasible in the 1944 season when the quantity of fruit to be handled proved greater than was anticipated. Thus for blanching 5,000 lb of cut apricots per hour, with a blanching time of 3½ min, a tray loading of 35 lb, with 3x6-ft trays crosswise, the blancher length is only 12½ ft. On the other hand, with peaches at 6,000 lb of cut fruit per hour, a blanching time of 12 min, and a tray loading of 45 lb, the length would have to be 40 ft. Obviously a blancher must be long enough for any commodity to be handled and should be provided with an adjustable-speed drive to permit changes in blanching time.

Where a continuous cutting table is used, it should not be connected directly with the blancher conveyor, or blancher time cannot be readily adjusted without disturbing the cutting. A short gravity-roller section should carry the trays from the cutting table to blancher. The floor space needed for a continuous blancher for fruits which take only a short blanch is not much of a problem, but with the slower fruits the space requirement has led to a consideration of cabinet blanchers.

With cabinet blanchers, where the steam is turned on when the car of trays is placed in the cabinet, and turned

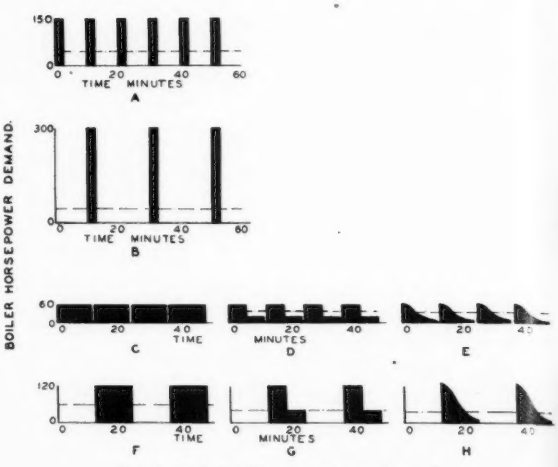

Fig. 3 Cabinet blancher steam demands

off at a time which is found by experience to give adequate blanching for the type of cabinet, steam supply and variety of fruit, more careful supervision is needed. With fruits such as apricots and freestone peaches, overblanching may result in serious juice loss subsequently in the sulfur house, and the operator must be careful with his timing.

To bring the atmosphere in a cabinet instantly to a temperature above 200 F would require an impractically high steam rate. A reasonable rule would seem to be to bring the cabinet above 200 F in one-third of the blanching time. Thus with apricots to be blanched in 3 min the cabinet should be above 200 F in one minute, while with cling peaches to be blanched in 12 min, 200 F should be attained in not over 4 min.

Because of the high initial steam rates, and the fact that the blancher is in use intermittently, the boiler horsepower cannot be estimated from the formula given for the continuous blancher. Observation of a limited number of blanchers in use during the 1944 season permits rough estimates of the peak demands.

With apricots, the steam rate to accomplish the desired rapid heating is estimated at about 150 boiler horsepower for a cabinet holding a single car loaded with 24 trays of fruit at 35 lb per tray. The steam should be cut off in less than three minutes, because of the unavoidable delay in venting the cabinet and removing the car. Since the steam is off until the next car is ready for blanching, the load on the boiler is extremely variable, and consequently it must be considerably larger than for a continuous unit to handle fruit at the same rate. In a plant equipped with cars which carry two stacks of 3x6-ft trays, the situation is even worse, for the peak load is twice as great. The demand on the boiler is illustrated at A and B in Fig. 3, for the single and double cars, respectively. A plant with six tunnels, each taking a car every hour, would be blanching six cars per hour. This could be handled in a single cabinet, with a 7-min interval for venting, opening the door, removing the car, and bringing up the next one, and closing the door. Two single cabinets would be desirable. With double cars, only one double-car cabinet would be required, and the operator would have a little more time between batches to move cars to the blancher and to the sulfur house, but the boiler would have to be larger even though the average load is no greater.

With cling peaches, for which the cabinet heating rate need not be so rapid, the boiler *(Continued on page 424)*

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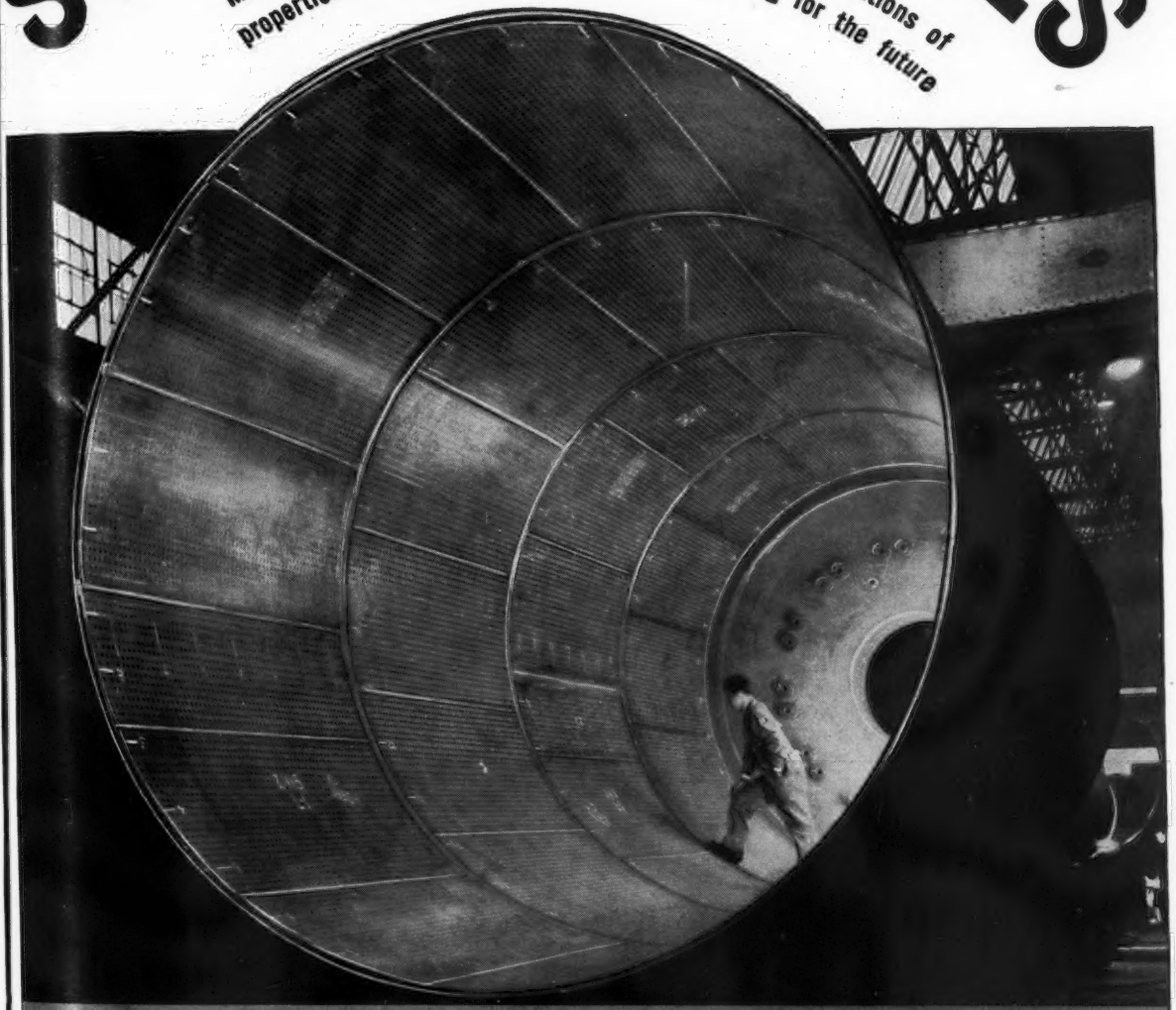

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Blanching Fruits for Dehydration

(Continued from page 422)

demand is estimated at 60 boiler horsepower for a single cabinet. For a six-tunnel plant, taking a single car every 72 min in each tunnel or five cars per hour, the demand on the boiler is illustrated in C, D, and E of Fig. 3. With a schedule of a car every 12 min, and a 12-min blanching time, at least two cabinets will be required.

In Fig. 3, C depicts blancher steam use with a steam valve manually operated and not adjusted during the blanching period. However, an appreciable saving in steam can be made by reducing the steam rate as the fruit warms up. As the fruit gets hotter it does not cause the steam to condense so rapidly as at first, and soon steam begins to blow through crevices at the door and the vents. With a temperature controller (direct-acting steam regulator) the steam rate will be about as shown at E. When a controller is not available, it would seem desirable to adjust the steam rate once during each blanch, as illustrated at D. For double-car cabinets, the demands are similarly illustrated in F, G, and H. Again, the steam demand is twice as great as with single-car cabinets, while the average load is about the same.

In order to simplify manual adjustment of the steam rate during blanching, a by-pass around the main valve can be provided, with another small valve and orifice which can be drilled by trial to provide a steam rate which will finish the blanch. Since the pressure in the manifold will be very low at the reduced steam rate, the data in Table 1 can be used to estimate the orifice size. For example, for 20 boiler horsepower at 100 lb per sq in gage pressure, the area of the hole would be 20/115, or 0.175 sq in. This is given by a 7/16-in drilled hole. A three-way valve would be even simpler that the two-valve arrangement suggested above.

With these provisions for manual adjustment of steam rate, it is advisable to have the valves for the cabinets conveniently located, to provide a clock for the operator, and to make up time indicators for each cabinet. These should be made with three adjustable hands which can be locked together. When the first hand is set at the time the steam is turned on, the second indicates the time which is found by trial to be correct for reducing steam flow, and the third the time steam is to be turned off. The intermediate hand is not essential with an alert operator who will note when steam is blowing from under the door.

Cabinets have been built of hollow tile, concrete, and plywood or galvanized-iron-lined framing. An appreciable steam economy can be effected by insulating the galvanized iron box with two inches of glass wool or rock wool. A large vent, possibly two square feet in area, should be provided in the ceiling for each single stack of trays. The vent should be closed with a cover conveniently operated by a control near the steam valve. The blancher door should operate freely, and it need not be very tight at the bottom, since air must be displaced when steam is admitted. Bottom vents which cannot be readily closed are undesirable, for since cabinets are usually installed outdoors, prevailing winds may sweep air into the box and give erratic blanching. The floor of the cabinet should pitch to drain.

With the customary branched-pipe steam-distributing manifold, it is desirable to have the car carried into the cabinet on a transfer truck, so that pipes permanently mounted on the sidewalls can deliver steam readily to the fruit through the open tray sides. Where the car is rolled in directly, the closed sides of the trays are next to the walls. This has led to the building of hinged manifolds (Fig. 4), either attached to swinging doors or independently mounted. One proposed design contemplates the use of a steam header with only a few openings, placed at the ceiling, with baffle plates under each opening to prevent direct impingement of a large stream of steam upon the top trays, and to direct the steam toward the sidewalls. With this arrangement the car could be rolled directly into the box without a transfer truck. The baffle plates are essential, for the steam may reach a velocity of 1500 fps as it emerges from the pipe, and a large stream at this velocity would injure the adjacent fruit, or blow it from the tray.

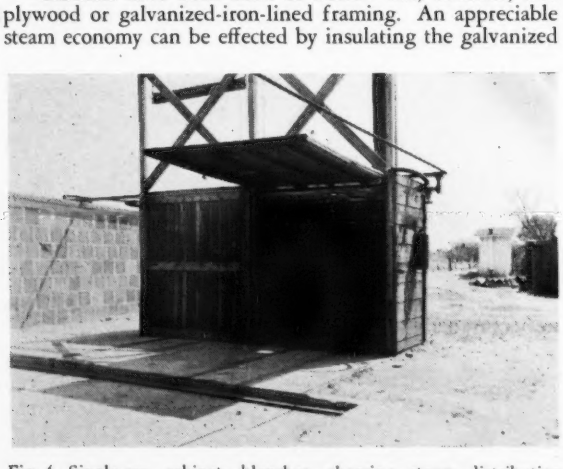


Fig. 4 Single-car cabinet blancher showing steam distribution pipes at back of cabinet and on door

Device for Handling Bales

TO THE EDITOR:

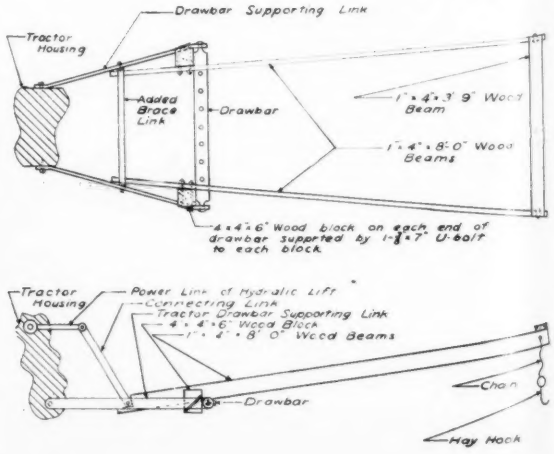
I WAS interested in the discussions on handling baled hay in AGRICULTURAL ENGINEERING for May and June.

Probably a good contrast in the scale of the operation can be found in Montgomery County, Virginia. I am enclosing a rough drawing of a device for lifting bales from the ground to the bed of either truck or wagon. You will notice that it is composed of three small pieces of timber mounted on the Ferguson tractor (1940-44 model).

The farmer who originated the device told me that he could lift two bales over the head of a man standing on a truck loaded with baled hay.

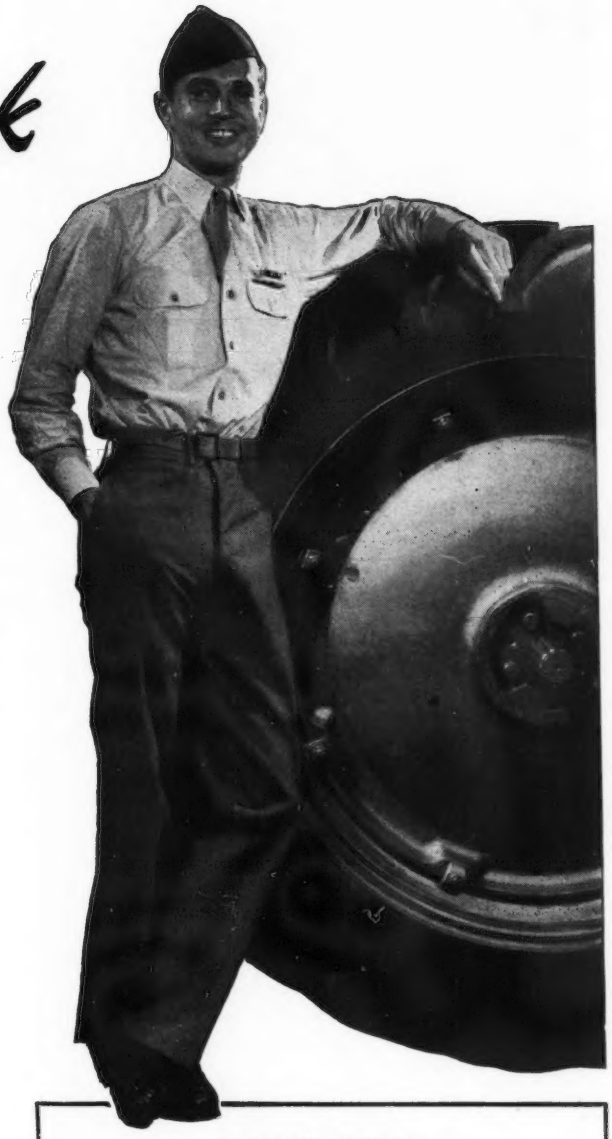
It seems to me that this is only one of the many jobs for which a tractor equipped with hydraulic equipment may be used.

PHELPS WALKER


Drawbar Supporting Link
Tractor Housing
Added Brace Link
Drawbar
1" x 4" x 3' 9" Wood Beam
1" x 4" x 8'-0" Wood Beams
4" x 4" x 6" Wood block on each end of drawbar supported by 1-3/4" x 7" U-bolt to each block
Tractor Housing
Power Link of Hydraulic Lift
Connecting Link
Tractor Drawbar Supporting Link
4" x 4" x 6" Wood Block
1" x 4" x 8' 0" Wood Beams
Drawbar
Chain
Hay Hook

Tommy's back

with new ideas about power



Have you ever stopped to think what Tommy—and the other farm boys who'll be returning from service—are going to do to the farm machinery business?

Take Tommy, for instance. He's back home with a lot of new ideas—about living—about farming—and about power.

A man doesn't spend years fighting and sweating out a war without promising himself he's going to have things easier afterwards.

He doesn't spend months and years surrounded by the most modern fighting machines without getting new ideas about power.

And Tommy hasn't.

He knows that in farming—as in fighting—power and reliable performance count. Where power and performance counted in fighting, he saw gasoline engines doing the job. And he probably knew that they were high compression engines to get the most power—and the most work or distance—out of a gallon of fuel.

Tommy knows that in the modern farm tractor he can get the reliable performance and convenience of gasoline plus the extra power and economy of high compression.

Tommy has this modern farm power available today because agricultural engineers brought the high compression engine to the tractor over 10 years ago. The job for agricultural engineers now is to keep pace with Tommy's future—to give him still better high compression tractors to take full advantage of the improved gasoline fuels now available.

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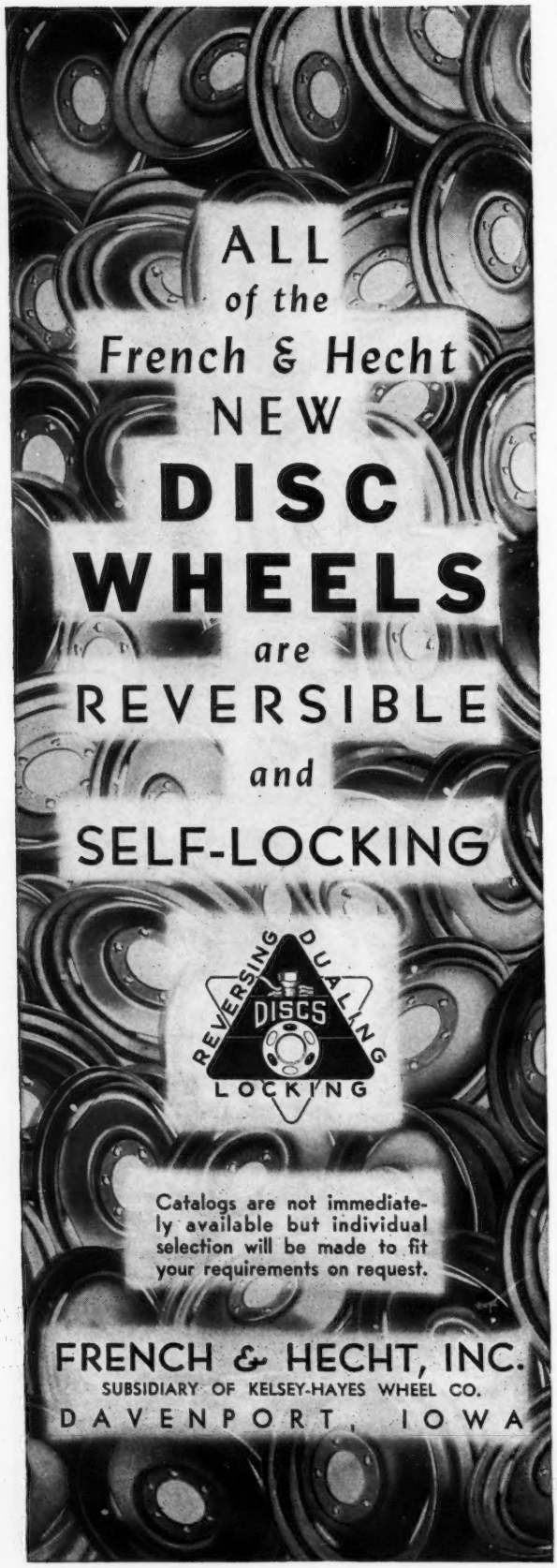
A HIGH COMPRESSION TRACTOR—Squeezes more work from each gallon of gasoline.

Works more acres each day; gets work done on time.

Gets more power from an engine of any given size.



NEWS SECTION

A.S.A.E. Fall Meeting

IN LIEU of its usual fall meeting, which was cancelled for 1945 just prior to the lifting of the government ban on conventions, the American Society of Agricultural Engineers will hold a one-day meeting in the Tower Ball Room of the Stevens Hotel, Chicago, on Friday, December 7.

The primary purpose of the meeting is to focus special attention on the more urgent problems or questions confronting the agricultural engineering profession. In addition to a keynote talk by the Society's President, J. Dewey Long, director of education and market research, Douglas Fir Plywood Association, a select group of speakers is being invited by the Meetings Committee to discuss the different phases of the agricultural engineering field represented by the Society's Power and Machinery Division, Rural Electric Division, Farm Structures Division, Soil and Water Division, and College Division.

Members of the Society are invited to offer suggestions as to topics and speakers for the program. In addition to the speakers selected, there will be opportunity for the presentation of prepared contributions by other members, especially those unable to attend the meeting. It is especially requested that such contributions be prepared and submitted well in advance of the meeting, in order that proper time and place may be provided for their inclusion on the program. Advance notice that such contributions are under preparation, as well as suggestions for program topics and speakers, should be mailed to the Society's headquarters office at St. Joseph, Michigan, from where they will be referred to the proper members of the Meetings Committee for consideration.

Meetings of the Council and Cabinet of the Society will be held on the day previous to the general meeting, and a dinner meeting of the Chicago Section will be held on the evening of December 7, the program of which will be devoted exclusively to the subject "Engineering Chore Jobs on the Farm."

North Atlantic Section Meeting

THE North Atlantic Section of the American Society of Agricultural Engineers will hold its 1945 meeting at the Roosevelt Hotel in New York City on November 12, 13, and 14. The first two days of the meeting will be devoted exclusively to general sessions, while the third day, November 14, will be given over to concurrent round-table programs built around the four major subjects of power and machinery, rural electrification, farm structures, and soil and water conservation and management.

An important consideration in connection with this meeting is the matter of hotel reservations for out-of-town members and friends of the Society. The Roosevelt Hotel will accept reservations for Sunday, Monday, and Tuesday nights — November 11, 12, and 13 — but the hotel warns that when reservations received have taken up all the available single rooms, it reserves the right to place two persons in a room. In view of this, it is recommended that those attending the meeting arrange wherever possible for two persons to occupy a twin-bed room.

Following are the speakers who have thus far accepted places on the program and the subjects of their talks:

Mrs. Nancy K. Masterman of the college of home economics at Cornell University will speak on the subject "Equipment and Services for Home Processors of Frozen Foods," which will be followed by W. A. Ramsey of the Cooperative G.L.F. Supplies, Inc., who will talk on the interest of his organization in quick freezing of food products.

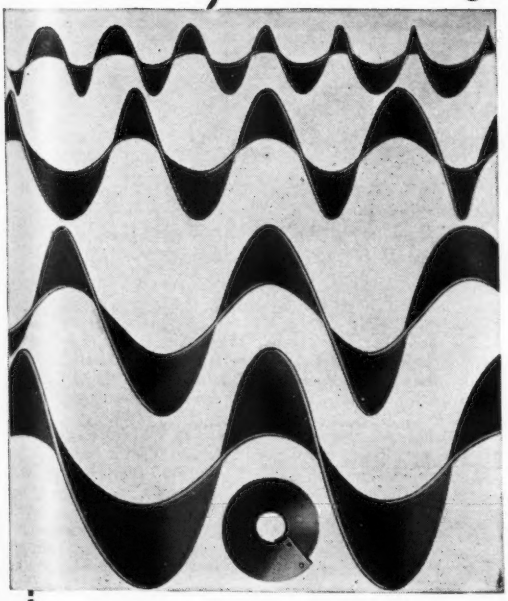
George W. Kable, editor of "Electricity on the Farm," will present the subject of poultry house ventilation by means of electric fans, and C. N. Turner, project director of the New York State Rural Electrification Council, will speak on new developments in the handling and storage of the hay crop.

Three speakers have been engaged to discuss the subject of handling manure. Dawson G. Womeldorff, agricultural engineer for the Public Service Company of Northern Illinois, will talk on manure loaders and barn cleaners. Howard S. Herzog of the Central Engineering Company will discuss mechanical barn cleaners, and Paul J. Newton, treasurer and general manager of Hertzler & Zook Company and consultant of New Holland Machine Company, will talk on the hydraulic manure loader.

R. C. Archer of the International Harvester Company will present the subject of "packaged power" for small farms, and K. W. Anderson, research engineer of Deere and Company, will discuss the subject of hydraulic controls for farm implements.

Dr. W. V. Lambert, assistant administrator, Agricultural Research Administration, U. S. Department of Agriculture, will address the meeting on what the USDA research program for the next year will contain of particular interest to agricultural engineers. In concluding his talk Dr. Lambert *(Continued on page 428)*

Screw Conveyor from LINK-BELT Serves Many Purposes!



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Increased use of screw conveyor on modern farm equipment is a natural development, as its special advantages become recognized. Application of screw conveyor to manure spreaders of recent design is an example of the resourcefulness of engineers, and illustrates the adaptability of this type of conveyor to various purposes, besides conveying bulk material such as grain, in the usual manner.

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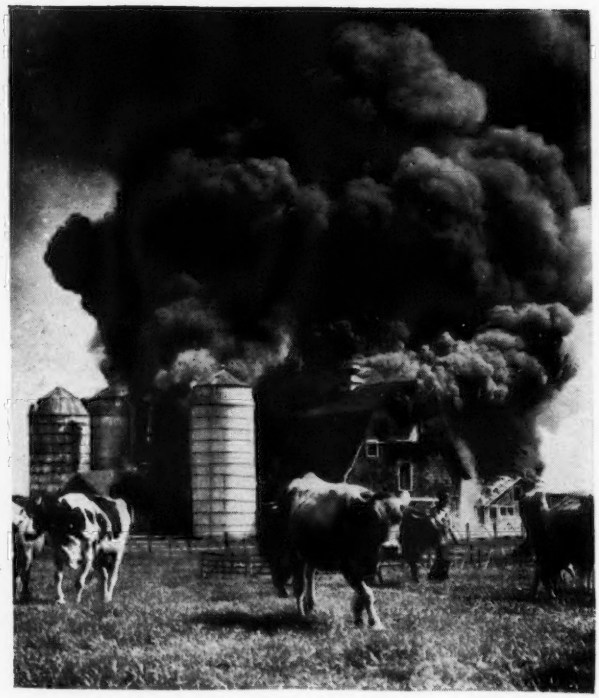

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BUY VICTORY BONDS

NEWS SECTION

(Continued from page 426)

will introduce Arthur W. Turner, assistant chief of the USDA Bureau of Plant Industry, Soils, and Agricultural Engineering, and in charge of the agricultural engineering divisions of the Bureau and will outline his responsibilities. Mr. Turner in turn will talk on the activities of these divisions of the Bureau and the lines of research in which they are presently engaged.

One of the high points of the program will be the address of the president of the Society, J. Dewey Long, director of education and markets, Douglas Fir Plywood Association, who will present his views on the outlook for the immediate future for the agricultural engineering profession.

At this writing, the program is not complete, and a few other numbers are still to be added. Members of the Society in the territory comprising the North Atlantic Section — that is, the New England states and New York, New Jersey, Pennsylvania, Delaware, and Maryland, West Virginia, District of Columbia, and the eastern provinces of Canada — will in due course receive printed copies of the program of the meeting. Members of the Society residing outside of the territory of the Section may obtain copies by writing the Society's headquarters at St. Joseph, Michigan.

Pennsylvania Section Meeting

THE Pennsylvania Section of the American Society of Agricultural Engineers will present a most interesting and timely program at its next meeting to be held in the Agricultural Engineering Building on the Pennsylvania State College campus at State College on Monday and Tuesday, October 22 and 23.

The meeting will open at 9:00 a.m., October 22, with a talk on the postwar challenge to agricultural engineering by Dr. F. F. Lininger, director of research, Pennsylvania State College. This will be followed by a talk by I. A. Daffin, president, New Holland Machine Co., on the manure loader and pickup baler, and a discussion of the rotary soil tiller by Harry Seaman, owner of Seaman Motors.

The afternoon program of the same day will open with a paper on farm ponds by E. B. Kinter of the U. S. Soil Conservation Service followed with a talk on fish production in farm ponds by G. L. Trembley of Penn State College. A demonstration on managed milking by I. E. Parkin, Penn State extension dairyman, will be injected into the middle of this program. The latter half of the program will be devoted to the subject of farm refrigeration, including a talk on the inspection of a multiple-temperature farm refrigeration unit by W. F. Ackerman and a paper on developments in freezing food by J. E. Nicholas, both of the Penn State agricultural engineering staff. J. D. Long of the Douglas Fir Plywood Association will discuss refrigerated storages for farms in the West. The afternoon session will close with a business meeting of the Section.

The Section dinner will be held at 6:00 p.m., the evening of October 22 at the Nittany Lion Inn, and the group will be honored in having as speaker for the occasion, A.S.A.E. President J. Dewey Long, director of education and markets, Douglas Fir Plywood Association.

The program for October 23 will be devoted practically exclusively to the subject of hay drying. The speakers at the forenoon session will include three Penn State agricultural engineers: A. W. Clyde on problems and principles of hay drying, R. J. McCall on types of distribution systems, and W. F. Ackerman on inspection of experimental installations. J. B. Stere, of the West Penn Power Co., will discuss types of fans for hay drying, and B. P. Hess, of the Westinghouse Electric Corp., will talk on types of motors.

The afternoon session will start off with the experiences of two Pennsylvania farmers in the management of hay driers, followed by a discussion by S. I. Bechdel and P. S. Williams of the Penn State dairy husbandry department on the feeding value of mow-cured hay. W. E. Keepper of the Penn State agricultural economics department will present the results of time studies in hay handling.

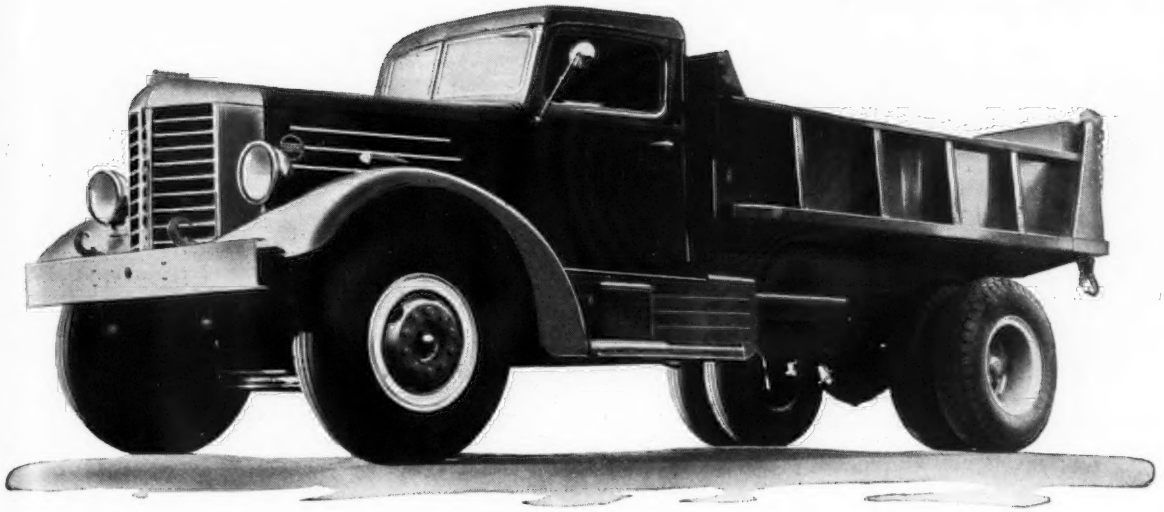
Following the adjournment of the meeting, a trip has been arranged for those in attendance to visit either the vegetable storage or hay drier projects at the College.

Washington Section Meeting

THE next meeting of the Washington Section of the American Society of Agricultural Engineers will be held on Friday, November 9, at 11:50 a. m., in Room 6962, South Agriculture Building, USDA. The speaker for the occasion will be J. Dewey Long, president of A.S.A.E., and director of education and markets, Douglas Fir Plywood Association.

Persons other than A.S.A.E. members who may be interested in the program are also invited to attend the meeting. As usual, it will be a luncheon meeting, and the price of the luncheon will be 50 cents. Advance luncheon reservations should be made with J. W. Simons, secretary, Washington Section, who is located at the USDA Research Center, Beltsville, Maryland, and whose telephone is WA 4200, extension 118. *(NEWS Continued on page 430)*

FOR EVERY TYPE OF TRUCK
IN EVERY TYPE OF SERVICE



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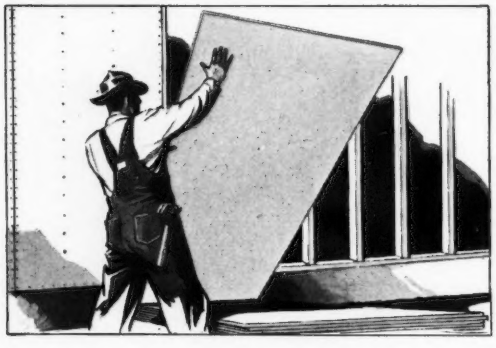

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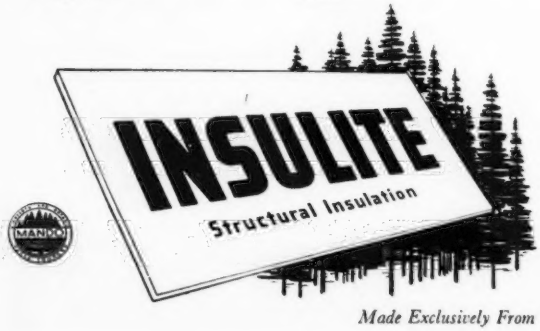

Made Exclusively From Wood

NEWS SECTION

(Continued from page 428)

Better Farm Buildings Association

DURING the past summer there was organized at Schenectady, New York, a voluntary, non-profit, unincorporated organization to be known as the "Better Farm Buildings Association," the purpose of which is "to render service to individuals, firms, corporations, and organizations (including, but without limitation, educational and research institutions) interested in developing and/or distributing plans for more efficient and economical farm buildings."

It is understood that the Association will promote such activities as the development of functional and design standards and working drawings for the construction of farm buildings through research, practical tests, and other available means, as well as more effective methods of construction of farm buildings and utilization of equipment and material.

The officers of the Association — incidentally, all members of A.S.A.E. — are as follows: President, Arnold Nicholson, managing editor, "The Country Gentleman"; vice-president, M. V. Engelbach, manager, field engineering, The Ruberoid Co.; secretary, Geo. A. Rietz, manager, farm industry division, General Electric Co.; treasurer, James L. Strahan, agricultural engineer, The Flintkote Co. These four officers, together with J. F. Schaffhausen, agricultural engineer, Johns-Manville Sales Corp., constitute the board of governors of the Association. Detailed information on the organization and its activities may be obtained by writing the secretary at Schenectady, New York.

MSC Offers Farm Equipment Short Course

A SPECIAL feature of the short-course program offered at Michigan State College this fall is a special training course in farm equipment service and sales. This training program is designed to meet the demands for training people to become service men, repairmen, partsmen, managers and salesmen for farm equipment dealers. The course consists of two 12-week periods of training at the College and two 12-week periods of placement training with pay, in dealers' shops, under College supervision. The following courses will be offered during the fall term: Service shop, farm equipment, tractors and power units, practical writing and speaking; service and repair shop methods, and typing and soil conservation. The courses offered during the spring term will be as follows: Rural electrification and refrigeration, accounting, store management, retail merchandising and salesmanship, business law, welding, and farm structures.

This course of study has been arranged by joint committees of the Michigan Farm Equipment Association and the faculty of Michigan State College. The work will be under the direction of A. W. Farrall, head of the agricultural engineering department, and Ralph W. Tenny, director of short courses. M. L. Bailey will be the student counselor and instructor in charge of the farm equipment courses. The program started September 20 and is being limited to not more than twenty students. It is intended to be of particular interest to returning servicemen and others who are interested in farm equipment.

Kable Wins N.S.C. Award

ACCORDING to announcement of the National Safety Council, George W. Kable, a past-president of the American Society of Agricultural Engineers, and editor of "Electricity on the Farm," was the unanimous choice of the judges for the winner, among competing national magazines, in the National Farm Safety Magazine contest conducted as a part of the nation-wide observance of National Farm Safety Week, July 22 to 28.

Judges in the contest were Keith Himebaugh, director of information, U. S. Department of Agriculture; Bristow Adams, formerly professor of agricultural journalism, Cornell University, and Maynard H. Coe, director, farm division, National Safety Council.

Arrangements are being made for formal presentation of the award, which may take place at the meeting of the A.S.A.E. North Atlantic Section at New York City in November.

A.S.A.E. Hay Drying Conference

PLANS are now under way for holding a two-day conference on the barn curing or drying of hay, which will be sponsored by the American Society of Agricultural Engineers. The program for the conference will be arranged by the Society's Committee on Hay Harvesting and Storage. No place or dates have yet been decided upon for the conference, but it will likely be held somewhere in the Middle West probably early in 1946. Suggestions as to speakers and topics to be given consideration on *(Continued on page 432)*

The FOX will give you all "3"

THE FOX Pick-up Hay Chopper and Silage Harvester does the three toughest jobs on the farm—Haying, Forage Harvesting, and Silo Filling.

With the FOX the farm for the first time is properly mechanized because with the FOX method:

- **you can mow, chop and load in one operation over 200 tons of grass silage a day.**
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- **one man, with the FOX, can pick up, chop and load, ready for the mow or stack 2 tons of dry hay in 12 minutes.**

The FOX is built by the Pioneers of Modern Forage Harvesting. WRITE US—we will be glad to tell you all about this marvelous machine.

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Secretary

FOX RIVER TRACTOR COMPANY

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usually pays for itself in a short time, and unlike machines built down to a price, gives years of trouble-free service.

★

NEWS SECTION

(Continued from page 430)

the program should be addressed to the chairman of the Committee on Hay Harvesting and Storage, C. B. Richey, Electric Wheel Company, Quincy, Illinois.

Personals of A.S.A.E. Members

William G. Beatty, until recently assistant agricultural engineer, Tombigbee Warrior District, Soil Conservation Service, USDA, at Winfield, Ala., has been transferred to the Peace River District at Arcadia, Fla., where he will have the rating of drainage engineer and will engage in land drainage work.

J. E. Collins recently joined the agricultural engineering staff of Virginia Polytechnic Institute as assistant extension agricultural engineer. He will specialize in rural electrification extension, working with county agricultural agents, electric power company representatives, equipment dealers, manufacturers, and REA cooperatives in furthering the use of electric service on the farm.

Everett H. Davis, formerly associate engineer of the Rural Electrification Administration, and more recently with the Soil Conservation Service, was recently appointed extension agricultural engineer for the State of Georgia. His work will include development of drainage and supplemental irrigation in Georgia, including design and supervision of pumping installations.

Robert E. Hartsock, formerly serving as an inspector in the aircraft division of J. I. Case Company, and more recently engaged as chief production engineer, Sawyer Electrical Manufacturing Co., has recently become associated with the Cal Management Service at Los Angeles, Calif., as engineer, in connection with which he will render a consulting service on new product design, manufacturing methods, and general plant operation.

Clarence J. Hurd recently resigned as chief of the agricultural engineering development division of the Tennessee Valley Authority to go into business for himself at West 203 Trent, Spokane, Wash. The business is known as the Hurd Farm Electric Supply and will specialize in the sale and servicing of farm electric equipment and complementary items.

Dale O. Hull has resigned as assistant to the director of education, technical department, Standard Oil Co. (Indiana), to accept appointment as extension agricultural engineer at Iowa State College, effective October 1.

W. M. Hurst, senior agricultural engineer, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA, who for several years has been engaged on Bureau research projects at Corvallis, Oregon, was recently transferred to the USDA research center at Beltsville, Md., where he will engage in studies of farm processing machinery.

Paul W. Jenicek has resigned as field engineer for the Chicago Bridge and Iron Co., of Eureka, Calif., and is now employed as a junior structural engineer of the J. F. Pritchard & Co., Kansas City, Mo. His new work consists of drafting and designing of steel and reinforced concrete details for the construction of power plants and petroleum processing plants.

M. M. Johns recently resigned as extension agricultural engineer, University of Tennessee, to establish his own business under the name of Johns Engineering and Equipment Co., at Knoxville, Tennessee, which will specialize in farm electric equipment.

Clarence A. Miller recently resigned as division rural service supervisor of the Ohio Power Co., to become associated as sales engineer, with McCune & Co., distributors of specialized farm equipment in five states.

Frank W. Peikert, formerly professor of agricultural engineering at the A. & M. College of Texas, and more recently connected with the development department of the Goodyear Tire and Rubber Co., has accepted appointment as professor of agricultural engineering at Michigan State College. He will specialize in the soil and water field.

Wiley D. Poole has been released from service with the U. S. Army Signal Corps and has returned to the Louisiana Agricultural Experiment Station as assistant agricultural engineer.

Russell R. Poynor recently resigned as a member of the agricultural engineering staff at Purdue University to accept a position as engineer specialist (agriculture) at the Canton works of the International Harvester Co., at Canton, Ill.

Phelps Walker, who has been serving as planning technician for the Soil Conservation Service at its project at Christiansburg, Virginia, has been transferred to one of the SCS projects at Blacksburg, Virginia, with change in rating to drainage engineer.

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You can increase efficiency and simplify operations of almost any type of equipment by making it portable. Investigate the uses of EWC Wheels, Axles, Springs, Tongues, etc., to give equipment added value.

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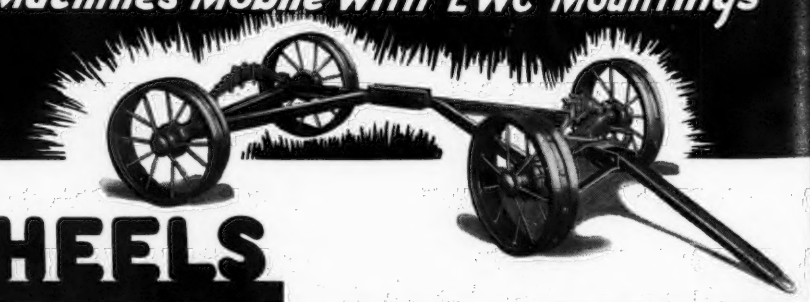

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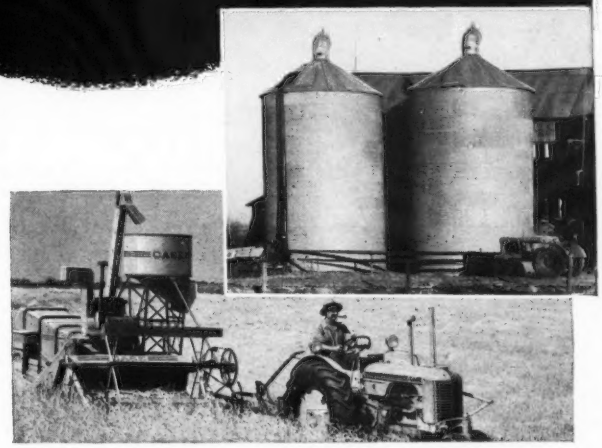

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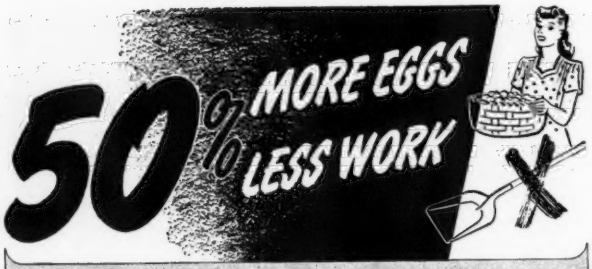
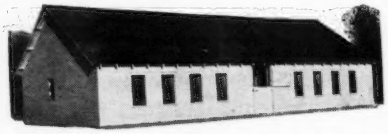


when you build this amazing HALL-VENT POULTRY HOUSE

Yes—poultry farmers who have built this amazing new Hall-Vent poultry house report as much as 50% increase in egg production—with half the work of changing litter! The secret is an entirely new method of *controlled* ventilation, using Balsam-Wool Sealed Insulation. The result is steadier egg production all year 'round—a house practically free from odor—no sweating of interior walls even in coldest weather.

Developed by famous poultry expert—The Hall-Vent type poultry house was developed by a nationally prominent poultry expert after years of research. To provide the efficient insulation needed, he chose Balsam-Wool Sealed Insulation—windproof, moistureproof, non-settling and completely sealed in an asphalted covering.

FREE PLANS!



Your lumber dealer will gladly furnish you with plans for building a Hall-Vent poultry house—without charge or obligation. If you are remodeling a poultry house, he has plans for a Trough-Vent house which embodies the same principles used in the Hall-Vent. See your lumber dealer soon—or mail the coupon for further information!

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SEALED INSULATION

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Gentlemen:
Please send me free the following—plans for the new Hall-Vent poultry house, one-story ☐, two-story ☐; plans for the Trough-Vent Remodeling System.

Name.....

Address.....*City*.....

County.....*State*.....

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Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Joseph E. Collins, assistant extension agricultural engineer, Virginia Polytechnic Institute, Blacksburg, Va.

Edgar E. Erwin, Jr., 1st Lt., 98th Engr. Regt., USA. (Mail) Box 414, Lake Providence, La.

Walter F. Forbrich, general farming, RR No. 1, Antioch, Ill.

Robert T. Lorenzen, Lt., Co. B, 22nd Inf., USA. (Mail) APO No. 4, Camp Butner, N. C.

Ralph N. Lunde, associate professor of agricultural engineering, Oregon State College, Corvallis, Ore. (Mail) 3020 Orchard St.

Robert P. Smith, general farm sales manager, Westinghouse Electric Supply Co., 40 Wall St., New York, N. Y.

Howard D. Skelton, irrigation engineer, Soil Conservation Service, USDA. (Mail) 608 So. 11th St., Coeur D'Alene, Idaho.

TRANSFER OF GRADE

Herman J. Finkel, agricultural engineer, Soil Conservation Service, USDA. (Mail) Canastota, N. Y. (Junior Member to Member)

D. E. Washburn, agricultural engineer, division of electrical development, Tennessee Valley Authority, Chattanooga, Tenn. (Junior Member to Member)

Richard L. Witz, agricultural extension engineer, Michigan State College, East Lansing, Mich. (Junior Member to Member)

Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request.

POSITIONS OPEN

DESIGN ENGINEERS (12) for combines, corn pickers, hay balers and tractors. Midwest farm machinery manufacturer. Salary, $250 to $325 a month. O-401

EXTENSION SPECIALIST in farm safety and fire prevention. Midwest state college. Salary, $2400 to $3200. O-403

SALES ENGINEERS (3) to work with dealers, farmers, etc. Large distributor of specialized farm equipment in five states. Salary and commissions to net $5000 to $8000. O-409

DESIGNERS (3) for farm tractors and machines. Southern farm machinery manufacturer. Salary, $3600 to $8000. O-411

LABORATORY TECHNICIAN for chemical analysis of feeds, etc. Midwest farm supply company. Salary open. O-412

ASSOCIATE AGRICULTURAL ENGINEER for sales promotion of building materials. Building materials manufacturer. Location, Middle West. Salary (middle range), $3600 to $4200. O-413

PRODUCT DESIGN DRAFTSMAN and layout draftsman (3 each) for farm tractors and implements. Midwest farm machinery manufacturer. Salary open. O-414

JUNIOR OR ASSISTANT AGRICULTURAL ENGINEER (P-1, P-2) for sweet potato machinery research in Mississippi. Federal agency. Salary, $2320 or $2980. O-415

ASSOCIATE AGRICULTURAL ENGINEER (P-3) for sugar cane machinery research in Louisiana. Federal agency. Salary, $3640. O-416

JUNIOR or ASSISTANT AGRICULTURAL ENGINEER (P-1 or P-2) for sugar cane machinery research in Louisiana. Federal agency. Salary, $2320 or $2980. O-417

AGRICULTURAL ENGINEER (P-3) for refrigerated apple storage research in state of Washington. Federal agency. Salary, $3640. O-420

AGRICULTURAL ENGINEER (P-2) to assist in grain storage studies in southeastern states. Federal agency. Salary, $2980. O-422

AGRICULTURAL ENGINEER (P-4) to serve as project leader for grain storage studies in southeastern states. Federal agency. Salary, $4300. O-423

FIELD ENGINEER for promotional and extension work on farm buildings in the south. Lumber trade association. Salary open. O-428

PRODUCT DEVELOPMENT AND FIELD ENGINEER for sales engineering work with farm machinery manufacturers. Middle West rubber manufacturer. Salary open. O-429

EXTENSION AGRICULTURAL ENGINEER to specialize in farm buildings. Southern state college. Salary open. O-430

CIVIL ENGINEERS III (3) for hydrological investigations in flood and low flow control and conservation. Midwest state agency. Salary, $310 to $360 per month. O-440

RURAL ELECTRIFICATION SPECIALIST for teaching and research. Southern state college. Salary open. O-434

AGRICULTURAL ENGINEER for designing and improving special machinery for muck soil operations. Midwest grower of special crops. Salary, $5000 to $10,000 plus bonus. O-436

DYNAMOMETER OPERATORS (2) for engine and tractor testing. Midwest farm machinery manufacturer. Salary open. O-437

RURAL ELECTRIC SERVICE ENGINEERS (8) for rural electrification promotion. Midwest electric utility. Salary, $2700 to $3600. O-438

AGRICULTURAL ENGINEER for teaching assistant in drainage and terracing and farm power and machinery, with opportunity to work for M.S. degree. Southern state college. Salary, $1500. O-439

(Continued on page 438)

. . . and Saves Hours of Chore Time Every Week

WITH milk 87 per cent water, it isn't enough to give dairy cows water three times a day. They need water oftener for maximum production . . . for body maintenance. That's why water cups are such a sure-fire money-maker.

Jamesway Water Cups do more than increase milk production two to five pounds per cow per day. They save the time spent in watering . . . make for fuller use of feed . . . help prevent disease . . . keep cows in better condition.

Cut Chore Time A Third

Automatic Water Cups are but one of many time and labor-saving money-makers developed by Jamesway . . . equipment that cuts feeding time . . . shortens chore time . . . saves walking . . . and steps up production. All are illustrated and described in the new Jamesway Farm Building Book.

You'll want a copy before you make any plans for building or remodeling and equipping a barn, poultry house, hog house, or any other farm building.

See Your Jamesway Dealer

Then see your Jamesway dealer. Equipment is necessarily limited because of the war, but he may have some of the equipment you need to produce more milk, eggs, and pork easier, faster, at lower cost. Write to Dept. A-1045.

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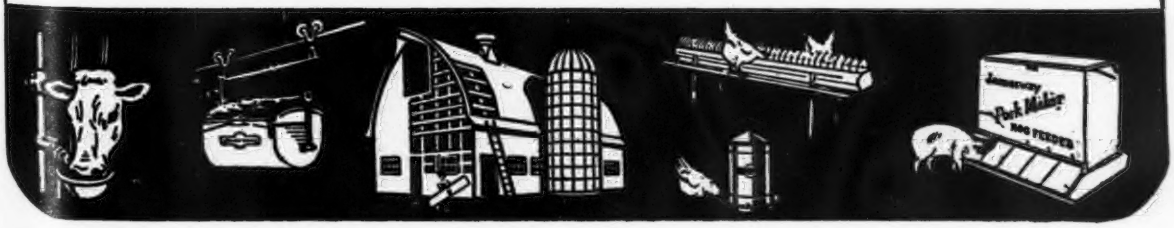
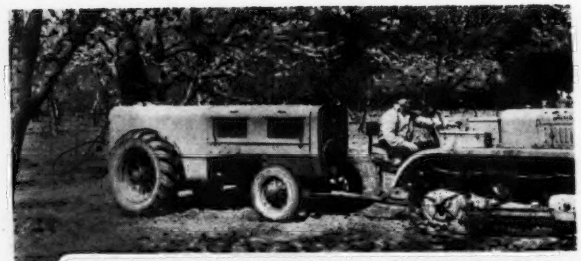
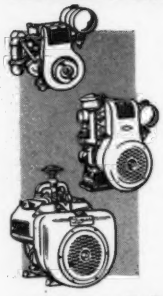




BEAN POWER SPRAYER
Typifies Integral Mounting of
WISCONSIN *Air-Cooled* ENGINE



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Because of the extreme compactness of Wisconsin Engines and their complete freedom from cooling system "accessories", and incidental attention, they are ideally adapted to installation on a great variety of farm and orchard equipment.

Today's swing is definitely toward Wisconsin air-cooled engine power for agricultural equipment. Engineering data gladly supplied.

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WISCONSIN MOTOR
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MILWAUKEE 14, WISCONSIN, U. S. A.
World's Largest Builders of Heavy-Duty Air-Cooled Engines

BELT LACING and FASTENERS for transmission and conveyor belts

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STEEL BELT LACING

World famed in general service for strength and long life. A flexible steel-hinged joint, smooth on both sides. 12 sizes. Made in steel, "Monel Metal" and non-magnetic alloys. Long lengths supplied if needed. Bulletin A-60 gives complete details.

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BELT FASTENERS AND RIP PLATES

For conveyor and elevator belts of all thicknesses, makes a tight butt joint of great strength and durability. Compresses belt ends between toothed cupped plates. Templates and FLEXCO Clips speed application. 6 sizes. Made in steel, "Monel Metal", non-magnetic and abrasion resisting alloys.

By using Flexco HD Rip Plates, damaged conveyor belting can be returned to satisfactory service. The extra length gives a long grip on edges of rip or patch. Flexco Tools and Rip Plate Tool are used. For complete information ask for Bulletin F-100.

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4677 Lexington St.
Chicago, Ill.

PERSONNEL SERVICE BULLETIN

(Continued from page 434)

CIVIL ENGINEERS II (3) for hydrological investigations in flood and low flow control and conservation. Midwest state agency. Salary, $260 to $210 per month. O-441

CIVIL ENGINEERS I (2) for hydrological investigations in flood and low flow control and conservation. Midwest state agency. Salary, $210 to $260 per month. O-442

ENGINEERING AIDES II (2) for drafting work. Midwest state agency. Salary, $175 to $220 per month. O-443

ENGINEERS (3) for design and development work on garden tractors and equipment for use with them, and on horse-drawn implements. Eastern farm machinery manufacturer. Salary open. O-444

AGRICULTURAL ENGINEER for design, promotion and extension work on farm structures. Middle West building materials manufacturer. Salary, $250 to $300 per month. O-445

AGRICULTURAL ENGINEERS (5) to advise and assist power distributors in use of electricity on farms in Tennessee Valley. Federal agency. Salary, $3000. O-446

ENGINEER for laboratory testing and research on farm machinery, tractors and engines. Midwest farm machinery manufacturer. Salary open. O-447

SALES ENGINEER to contact and assist design engineers of farm machinery in design of power transmissions. New England power transmission manufacturer. Salary open. O-448

ASSISTANT EXTENSION AGRICULTURAL ENGINEER as full-time specialist in safety and farm buildings work. Eastern state college. Salary, $3000 or more. O-449

AGRICULTURAL ENGINEERS (several) for work in both design and distribution of farm equipment at several locations in Middle West. Salary to fit qualifications. O-450.

AGRICULTURAL ENGINEER for research and development on machinery for applying insecticides and fungicides to farm crops. Eastern farm machinery manufacturer. Salary, $3000 to $4000. O-451

ASSISTANT OR ASSOCIATE AGRICULTURAL ENGINEER for research and teaching in irrigation, soil erosion, and land development work. Western state college. Salary, $3000 to $3600. O-452

AGRICULTURAL ENGINEER to supervise work in farm machinery development and be responsible for related research in equipment to meet needs of farmers in Tennessee Valley. Federal agency. Salary, $4300. O-453

AGRICULTURAL ENGINEER to serve as associate project leader on research and development projects relating to irrigation, water systems, frost control equipment, terracing equipment, etc., in Tennessee Valley. Federal agency. Salary, $3000. O-454

AGRICULTURAL ENGINEER to assist associate project leader in conducting joint research projects relating to irrigation, water systems, frost control equipment, terracing equipment, etc., in Tennessee Valley. Federal agency. Salary, $2100. O-455

IRRIGATION ENGINEER for experimental work on use of water in irrigation, etc. Midwest state college. Salary, $3400 or more. O-456

ASSISTANT AGRICULTURAL ENGINEER for research work in farm structures and rural electrification. Midwest state college. Salary, $3200 or more. O-457.

DISTRICT MANAGER to make recommendations for and sell electric fly-screen installations in central New York state. Eastern manufacturer. Salary, $3000 to start. O-458.

DESIGNERS, class A (3), for design of grain, corn, hay, and silage harvesting machinery. Midwest farm machinery manufacturer. Salary, $275 per month. O-459

DESIGNERS, class B (3), for layout work on grain, hay, and silage harvesting machinery. Midwest farm machinery manufacturer. Salary, $235 per month minimum. O-460

AGRICULTURAL ENGINEER (assistant professor rank) for teaching and research work in all branches of agricultural engineering. Eastern state college. Salary, $2800 per year. O-461

AGRICULTURAL ENGINEER for drafting, design, and development work on farm machinery. Eastern farm equipment manufacturer. Salary open. O-462

EXTENSION SPECIALIST in farm structures. Midwest state college. Salary, $3000 to $3600. O-463

RESEARCH SCHOLARSHIP in connection with dairy barn research project. Midwest state college. Salary, $1400, with opportunity to carry up to 5 credits of college work. O-464

PROMOTION DIRECTOR to supervise and plan structures activities in farm and industrial fields, at Midwest location. Eastern trade association. Salary, $6000 to $7500. O-465.

JUNIOR PROMOTION MAN (on farm structures) to prepare publicity, advertising, etc., and to work with colleges, 4-H clubs, etc., at Midwest location. Eastern trade association. Salary, $3500. O-466

ASSISTANT EXTENSION AGRICULTURAL ENGINEER for all branches of field. Southwest state college. Salary, $3200 to $3400. O-467

AGRICULTURAL ENGINEER to develop and design pumps and other farm implements. Western New York farm machinery manufacturer. O-FM

POSITIONS WANTED

AGRICULTURAL ENGINEER (B.S. degree) desires research or design and development work in rural electrification or with general public utility, in either private industry or public service. Age 39. W-203

AGRICULTURAL ENGINEER desires sales and/or engineering work in Southwest U. S. ONLY, on salary and commission. Ten years' farm machinery sales experience. Age 42. W-204

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering and service work in farm structures or building materials field. Age 39. W-208

AGRICULTURAL ENGINEER desires product design and development work in farm machinery industry, or college teaching of power and machinery. Age 32. W-209

MINING ENGINEER (ag-eng. experience) desires sales engineering and service work in farm equipment industry. Age 25. War veteran. W-210

MECHANICAL ENGINEER (B.M.E. degree and ag-eng. experience) desires sales engineering and service work in rural electrification field. Age 46. Salary, $4000. W-212

AGRICULTURAL ENGINEER (B.S. degrees in both ag and ag-eng.) desires teaching, extension or research work in power and machinery. Age 39. W-213

(Continued on page 440)

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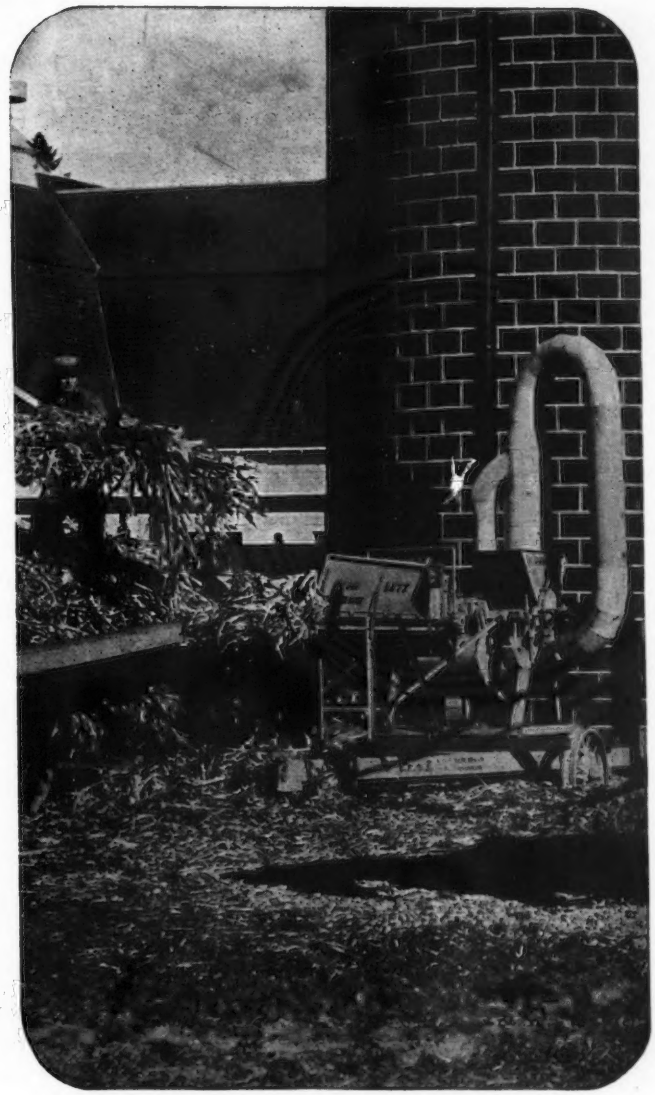

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PERSONNEL SERVICE BULLETIN

(Continued from page 438)

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering or service work in rural electrification or farm structures fields. Age 26. War veteran. Salary, $3000. W-214

AGRICULTURAL ENGINEER (B.S. degree) desires research, sales engineering, or design and development work in farm equipment industry, Age 27. Salary, $4000 to $5000. W-216

AGRICULTURAL ENGINEER (Equivalent of M.S. degree) desires design, development or research work in farm equipment industry. Age 35. Salary, $4200 and up. W-127

AGRICULTURAL ENGINEER (B.S. degree) desires development or sales engineering and service work in farm machinery industry. Age 29. Salary, $4200 to $4800. W-218

AGRICULTURAL ENGINEER (B.S. degree) desires sales or sales engineering and service or design and development work in farm structures field. Age 35. War veteran. Salary, $5000. W-219

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering and service or research and development work in private industry in soil conservation, rural electrification, or power and machinery field. Age 25. War veteran. Salary, $2500. W-220

AGRICULTURAL ENGINEER (B. S. degree) desires development, research or sales work in power and machinery or rural electrification field. Age 24. War veteran. W-221

AGRICULTURAL ENGINEER (B.S. degree) desires development work in soil and water field with public agency or sales work in rural electrification. Age 24. War veteran. Salary, $2800. W-223

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or sales engineering and service work in farm structures field. Age 26. War veteran. W-224

AGRICULTURAL ENGINEER (B.S. degree) desires design, development, and research or sales engineering work in farm machinery field. Age 27. Salary, $3200. W-225

AGRICULTURAL ENGINEER (B.S. degree) desires teaching and extension or research work in rural electrification or farm structures with public service agency. Age 27. Salary, $225 to $325 per month. W-226

AGRICULTURAL ENGINEER (B.S. degree in both Ag. and M.E.) desires design and development work in farm machinery field. Age 29. Salary, $350 per month minimum. W-227

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or research work in farm machinery field. Age 29. Salary, $3500 to $5000. W-228

AGRICULTURAL ENGINEER (B. S. degree) desires sales engineering or service work in power and machinery, rural electrification, or soil and water field, with public service agency or private industry. Age 25. War veteran. W-229

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or research work in farm structures or soil and water field, either private industry or public service. Age 35. Salary, $5000. W-230

AGRICULTURAL ENGINEER (B.S. and M.S. degrees) desires research, teaching, and/or extension work in rural electrification with public service agency or in private industry. Age 35. Salary, $4000 to $8000. W-231

AGRICULTURAL ENGINEER (B.S. degree) desires design and development work in farm machinery field. Age 26. War veteran. Salary, $2000 a year. W-232

AGRICULTURAL ENGINEER desires design, development, research, sales or sales engineering and service work in farm structures field only, in either private industry or public service. Age 40. Salary, $4500 minimum. W-233

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering and service work in farm machinery field. Age 30. War veteran. W-234

AGRICULTURAL ENGINEER (B.S. degree) desires design and development work in farm machinery or farm structures field in either private industry or public service. Age 30. Salary, $3600. W-235

AGRICULTURAL ENGINEER (B.S.A. and M.A. degrees, major in ag-eng) desires sales engineering and service work in farm machinery industry, or power and machinery or soil and water work with federal agency or state extension service. Age 43. War veteran. W-236

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or sales engineering and service work in farm machinery field or research and development in soil and water field. Age 26. War veteran. Salary, $3200 to $3500. W-237

AGRICULTURAL ENGINEER (B.S. degree) desires time-study or service work in farm machinery industry. Age 28. Salary, $2500 to $3000. W-238